University of the National Education Commission, Krakow

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Proceedings of the 20th European Conference on Innovation and Entrepreneurship

University of the National Education Commission, Krakow, Poland

25-26 September 2025



Iwona Lupa-Wójcik and Dorota Murzyn

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Proceedings of the

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ECIE 2025

25-26 September 2025

Hosted By

University of the National Education Commission, Krakow, Poland

Edited by

Dr. Iwona Lupa-Wójcik and

Prof. Dorota Murzyn

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About the 20th European Conference on Innovation and Entrepreneurship, 2025

The European Conference on Innovation and Entrepreneurship (ECIE) is a prominent academic conference that has been held annually for 20 years. The conference serves as a vital forum for scholars, researchers, entrepreneurs, and practitioners to explore the latest trends, research findings, and practical applications in the fields of innovation and entrepreneurship. ECIE is committed to advancing the understanding of how innovation and entrepreneurship drive economic growth, competitiveness, and societal progress.

ECIE is recognized for its rigorous peer-reviewed conference proceedings, which ensure that the research presented is of high academic quality and practical relevance. The Proceedings of the 20th ECIE, 2025 includes academic research papers, PhD research papers and Master's research papers as well as work-in-progress papers, which have been presented and discussed at the conference. The proceedings are of an academic level appropriate to a research audience including graduates, post-graduates, doctoral and post-doctoral researchers. All papers have been double-blind peer reviewed by members of the Review Committee.

Aims and Scope

The primary aim of ECIE is to foster a comprehensive understanding of innovation and entrepreneurship by bringing together, from around the world, diverse perspectives from academia, industry, and policy-making. The conference seeks to bridge the gap between theory and practice, offering insights into the processes that fuel innovation and entrepreneurial ventures. ECIE encourages the exploration of new ideas, the development of innovative business models, and the identification of best practices that can be applied across different sectors and regions.

The scope of the conference is broad and interdisciplinary, encompassing a wide range of topics related to innovation management, entrepreneurial ecosystems, and the role of technology in driving business growth. ECIE also emphasises the importance of education and training in fostering entrepreneurial skills and mindsets, as well as the role of policy and government in supporting innovation and entrepreneurship.

Topics Covered

ECIE covers a diverse array of topics that reflect the dynamic and evolving nature of innovation and entrepreneurship. The call for papers asked for contributions that considered the following topics. In addition, the committee welcomed papers on a number of specialist mini-tracks which can be seen at the end of this list.

Innovation Management:

- Innovation Processes and Models
- Managing R&D and Product Development

- Innovation in SMEs and Large Enterprises.

Entrepreneurial Ecosystems:

- Startup Ecosystems and Incubators
- Social Entrepreneurship
- Corporate Entrepreneurship and Intrapreneurship

Technology and Digital Innovation:

- Digital Transformation
- Emerging Technologies
- Innovation in the Digital Economy

Entrepreneurship Education and Training:

- Entrepreneurial Mindset Development
- Curriculum Design and Pedagogy
- Experiential Learning

Innovation and Entrepreneurship Policy:

- Government Policies and Support Programs
- Regional and National Innovation Systems
- Public-Private Partnerships

Sustainable Innovation and Entrepreneurship:

- Sustainability and Green Innovation
- Circular Economy
- Impact of Innovation on Society

Global Perspectives on Innovation and Entrepreneurship:

- International Entrepreneurship
- Innovation in Emerging Markets
- Cross-Cultural Entrepreneurship

Research Methods in Innovation and Entrepreneurship:

- Quantitative and Qualitative Approaches
- Action Research and Participatory Methods
- Innovation Metrics and Impact Assessment.

Mini Tracks

Experts in the field proposed mini tracks on the following topics. Papers accepted on these topics after the double-blind peer review process were presented as mini tracks at the conference and are also published in these proceedings.

- Social Innovation Using AI: Reimagining Entrepreneurship for Sustainable Societal Impact

- The Third Mission of Universities: Fostering Innovation and Entrepreneurship
- Innovative Curriculum Design in Entrepreneurship Education Bridging Theory and Practice to Develop Entrepreneurial Competencies and Mindset
- Gendered Landscapes and Perspectives in Innovation and Entrepreneurship
- Innovation Practices in SMEs Business Management and Operations

The programme from the 2025 conference can be downloaded from here and full details about the conference can be seen from the conference website: https://www.academic-conferences.org/conferences/ecie/

ECIE Preface

These proceedings represent the work of contributors to the 20th European Conference on Innovation and Entrepreneurship (ECIE 2025), hosted by University of the National Education Commission, Krakow, Poland on 25-26 September 2025. The Conference Co-Chairs are Dr Iwona Lupa-Wójcik and Prof. Dorota Murzyn, while the Programme Chairs are Dr Marta Czyżewska and Dr Wojciech Maciejewski, all from the University of the National Education Commission, Poland.

ECIE is now a well-established event on the academic research calendar and now in its 20th year the key aim remains the opportunity for participants to share ideas and meet the people who hold them. The scope of papers will ensure an interesting two days. The subjects covered illustrate the wide range of topics that fall into this important and ever-growing area of research.

The opening keynote presentation is given by Prof. Zoran Wittine, from the University of Zagreb, Croatia, who will be speaking about "Bridging the Innovation Gap: Can Europe Strengthen Its Global Competitiveness?" There will be a second keynote speech after lunch on day one from Anna Ledwoń-Blacha, Co-founder & Creative Director of More Bananas who will be discussing "Strategic Thinking in the age of Generative AI: Between Human Intuition and Algorithmic Overconfidence." The second day of the conference will open with an address from Prof. Maria Urnaniec, Krakow University of Economics, Poland on the topic of "Entrepreneurship in the Age of AI: How Technology Shapes New Market Opportunities."

With an initial submission of 209 abstracts, after the double blind, peer review process there are 134 Academic research papers, 9 PhD research papers, 1 Non-Academic papers and 3 work-in-progress papers published in these Conference Proceedings. These papers represent research from Bangladesh Brazil; China; Colombia; Croatia; Cyprus; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Iceland; India; Indonesia; Ireland; Isreal; Italy; Japan; Latvia; Lithuania; Malaysia; Morocco; Netherlands; Nigeria; Norway; Oman; Poland; Portugal; Saudi Arabia; Slovakia; South Africa; Sweden; Switzerland; Turkey; UAE; UK; USA

We would like to thank everyone who participated in this event.

Dr. Iwona Lupa-Wójcik and Prof. Dorota Murzyn

University of the National Education Commission,

Krakow, Poland

September 2025

Biographies of Chairs and Keynote Speakers

Conference and Programme Chairs



Dr. Iwona Lupa-Wójcik Doctor of Economic Sciences, Assistant Professor at the Department of Entrepreneurship and Social Innovation at the University of the National Education Commission, Krakow (Poland). Author of books and several dozen scientific articles on social media, marketing, new technology (including AI), and social entrepreneurship. Member of many research and teaching projects related to social entrepreneurship, including INN@SE - Innovative Social Entrepreneurship with youth engagement (Erasmus+) or Responsible Business – from East to West.



Prof. Dorota Murzyn Associate professor and head of the Department of Entrepreneurship and Social Innovation at the University of the National Education Commission, Krakow (Poland), chair of the council of economics and finance scientific discipline at UKEN. Author of many publications on EU policy, innovation and social entrepreneurship. Expert and advisor on EU funds, cooperating with the Joint Research Center (European Commission), Polish Ministry for regional development, companies and NGOs. Manager and contractor of numerous projects co-financed by the EU, including INN@SE - Innovative Social Entrepreneurship with youth engagement (project coordinator).



Dr. Marta Czyżewska doctor of economic sciences, assistant professor at the Department of Entrepreneurship and Social Innovation at the University of the National Education Commission, Krakow (Poland). Team member of internationational projects such as INN@SE - Innovative Social Entreprenuership with youth engagment, SeGoesGreen - Integrating Nature-Based Solutions into higher education towards exploiting the transformative potential of Social Economy for a green and inclusive future. Author of several publications on entrepreneurship, social entrepreneurship and venture capital. Mentor and advisor for startups under incubation and acceleration processes.



Dr. Wojciech Maciejewski assistant professor of economics, author of publications and books in the area of entrepreneurship, social entrepreneurship, education for entrepreneurship, decision-making process. He took part and is taking part in international research and development projects such as INN@SE - Innovative Social Entrepreneurship with youth engagement, SeGoesGreen - Integrating Nature-Based Solutions into higher education towards exploiting the transformative potential of Social Economy for a green and inclusive future.

Keynote Speakers



Prof. Zoran Wittine is an Associate Professor at the Department of International Economics, Vice-Dean for infrastructure and business processes at the University of Zagreb and a member of the University Senate. In addition, he is also a member of the Commission on Customs and Trade Facilitation within the International Chamber of Commerce; member of International project management association (IPMA) and a senior member of the International Economics Development and Research Center. His areas of expertise include international business, international entrepreneurship, social innovation education, social entrepreneurship and risk management. He is a member of the editorial boards of several international scientific journals and was a member of the organizational and technical committee of many international conferences. He was a leader of many international/EU-funded projects, of which most of them were focused on the topics of education development, digitalization, social innovation, social entrepreneurship, innovation, skill development and capacity building. In addition, he was an associate on many professional projects and had an active role in creation of the "Industrial strategies of The Republic of Croatia 2014-2020". Before taking up a position at the University of Zagreb, he worked as a management consultant at McKinsey&Company, where he worked on projects of corporate restructuring, corporate integration processes, improvement of corporate efficiency, etc.



Prof. Maria Urbaniec is an Associate Professor and the Head of the Department of Entrepreneurship and Innovation at the Krakow University of Economics, Poland. She earned her Master's degree and PhD in Economics at the International Graduate School Zittau of the Technische Universität Dresden, Germany. She has authored or co-authored over 200 scientific publications, including articles in journals indexed in Web of Science. Her main research interests include entrepreneurship, innovation, sustainable development, and the digital transformation. She has extensive experience in project management, having participated in numerous national and international research and educational projects funded by organizations such as the European Commission, International Visegrad Fund, INTERREG Central Europe, German Federal Environmental Foundation (DBU), the Polish Ministry of Education and Science, and the National Bank of Poland. She is an expert for the European Commission, evaluating project proposals applying for EU funding under the European Innovation Council and SMEs Executive Agency. She is a member of both international and national scientific organizations, including the European Council for Small Business and Entrepreneurship (ECSB) and the Polish Association of Environmental and Resource Economists (PSESiZN). She also serves as the Vice President of the Polish Economic Society (PTE) and the President of its Krakow Branch. Additionally, she is a member of the Central Committee for the Entrepreneurship Olympiad in Poland. Her international academic experience includes research fellowships and study visits at leading universities worldwide in Austria, Finland, Germany, Indonesia, the Netherlands, Spain, the United Kingdom, and Vietnam. Among her numerous honors are the Medal of the National Education Commission, and an honorary award from the National Academy of Pedagogical Sciences of Ukraine for her role in advancing international scientific collaboration.



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Innovation Practices in Property Businesses: A Family Enterprise Case Study

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Abstract: Innovation is about developing new ways to improve productivity and quality of service and achieve business goals and objectives. It is becoming critical for property enterprises to innovate and work smart to scale up and stay ahead of the competition. This could be achieved by utilising digitalisation and Artificial Intelligence (AI) to support management activities, streamlining investment ventures, or opening new venues for cost-effective solutions. It is becoming essential for property SMEs to ensure that they deliver on time, meet the regulations' requirements, and their customers' demands, and achieve their business goals. New innovative products or services could disrupt current property business activities and operations, and present new challenges for SMEs. Moreover, innovation can help property businesses implement smart methods and new, more efficient procedures in their operations and add value to their products and/or services that can lead to high returns. This paper introduces our family business innovation framework and system, which was adapted from Kashny et al. (2015). Our enterprise uses an innovation strategy to support the business teams in implementing the necessary tools and systematisation and achieving strategic advantage while managing risk. This helps us deal with business management and financial challenges, market changes, and unexpected circumstances. The lack of planning and strategy could impact the business, generating revenues and maintaining growth. This paper presents the entrepreneurial aspects of applying innovative solutions to property enterprises' business management and operations. It aims to introduce a real-life case study about some of the challenges property enterprises face in general and Anzar Property Group in particular. The paper will present ongoing entrepreneurial activities in a family-owned business that specialises in the residential property business. It will also show the innovation process and practices applied by Anzar Property Group in its entrepreneurial business activities, operations, and development.

Keywords: Innovation practices, Innovation and entrepreneurship in property businesses, innovative solutions for property asset management

1. Introduction

Nothing remains fixed forever, and businesses are not exceptional; business leadership and members change, innovation systems and strategy change, and in family businesses, newborn members of the business founders arrive, other members die, and relationships and responsibilities develop and change. Despite all those possible changes, certain elements, such as parents, brothers, sisters, cousins, etc., do not change in the family enterprise. Innovation is a continuous process, as relying on one innovative method is insufficient to deal with business leadership and strategy change, and for long-term progress and sustainability. Innovation is not just about making change but about balancing progress and change, for example, using the business heritage and accumulated knowledge in the family enterprise and the ability to offer new services, products, or business systems and processes (Howorth and Robinson, 2021). Innovation is not about using advanced technology such as AI. Still, it happens at various levels of the 4Ps - process, product, position, and paradigm, using two approaches to innovation, as follows (Tidd and Bessant, 2015) (Howorth and Robinson, 2021):

- Radical innovation affects the principal nature of the business model or function, leading to a thorough change in its strategy or operations.
- Incremental innovation involves minor changes to current business practices or activities, making it the preferred approach by family businesses.

Figure 1 shows our innovation framework developed over the years to help us follow a disciplined approach supported by clear six steps for innovation, as follows:

1. Ideation: Brainstorm business needs, observe challenges, and identify gaps in the market and potential technology tools.
2. Articulation: Formulate a business strategy that meets the business goals and objectives.
3. Experimentation: Identify critical functions to be performed and necessary tools to utilise, and develop a prototype for demonstration.
4. Contribution: Allocate necessary financial and/or in-house resources to develop a working technology and arrange for licensing and IP (intellectual property) if required.
5. Evaluation: Test and validate the developed technology in an operational environment.
6. Commercialisation: The qualified developed technology is ready for marketing and selling to potential customers.



Figure 1: Innovation Framework

As part of the innovation framework, businesses should have an innovation system to allow them to develop a clear innovation strategy to help them grow and compete. An innovation system consists of four main elements, as shown in Figure 2. Family businesses need to develop an innovation strategy to help them determine what they need to achieve. The strategy includes an innovation plan, direction, and aims and objectives, which should align with the family business objectives. The innovation strategy must cover the innovation and business challenges that must be dealt with, the required resources, and the actions to take. An innovation model represents and visualises or conceptualises the innovation strategy, making it more straightforward for all business members and stakeholders. The innovation process describes the main actions to be taken to help the family business achieve its innovation goals and objectives. Innovation tools are necessary to implement the innovation process, execute its actions, perform specific tasks, and put the selected actions into practice.

2. Innovation in Property Management Business

Integrating innovation in property management is changing the property facility management and operations, making systems and processes more effective and efficient. Tenants' demands for quality living have increased, adding extra pressure on property businesses to adopt modern innovative home appliances and management practices. With the introduction of innovative solutions such as AI, data analytics, IoT, etc., the property management procedures and mechanisms have been transformed recently, redefining the property management business as follows:

- Smart homes: Digital technologies have been introduced to support property managers or tenants in making data-driven and informed decisions, optimising their properties' performance.
- Automation: Smart devices such as IoT have been used to allow property managers to monitor the condition of their properties remotely, identifying issues such as moisture or humidity or specifying malfunctioning apparatus early before problems escalate, promoting sustainability and energy-efficiency solutions.
- Management platfroms: Many onine property management application platforms, and tools have become available to property managers. These applications allow managers to receive repair reports from their tenants and interact and communicate with them, enhancing the tenants' experiences.

Family property businesses that take innovation seriously can achieve strategic advantages while managing risks. Therefore, organisations cannot stand still while the business landscape and markets continuously change. This section delves into the importance of developing an innovation strategy and the implications for businesses lacking a plan and strategy for dealing with market challenges. An innovation model has been developed to align with the developed innovation framework and strategy. This model has been designed to translate the strategic framework and vision into tangible results. This is to ensure that the innovation strategy has been properly executed. The model has six business elements designed to address the above business challenges. Each aspect is addressed individually and supported by the necessary systems and processes using AI technologies. AI has revolutionised numerous industries and sectors, and the real estate sector is no exception. It presents property

business entrepreneurs and start-ups with unique opportunities to innovate, disrupt the property industry, and develop innovative solutions in a competitive market. However, this disruption poses new challenges, particularly in understanding and utilising AI to establish 'smart' businesses.

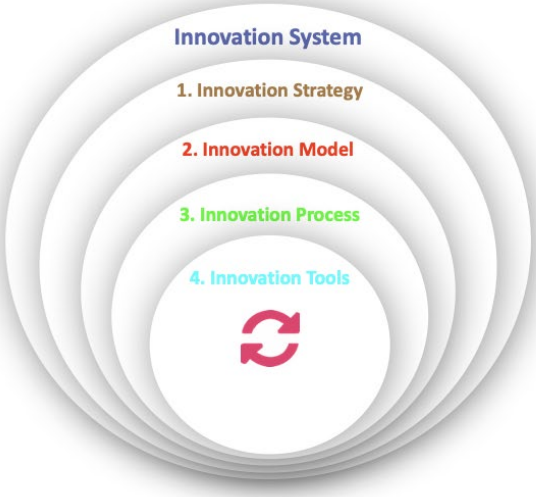


Figure 2: The innovation system adapted from Kashny et al. (2015)

AI techniques, particularly machine learning, can transform the real estate market and offer practical tools to address specific challenges. For instance, their integration can lead to more precise property valuations, enhanced service quality, and improved customer experiences. Technological advancements in AI will reshape the roles of real estate businesses, including asset management, property development, and estate agents. Our AI-based innovation model, depicted in Figure 3, encompasses six critical activities within the company. This model aligns with our innovation framework and business strategy for expanding our property portfolio. Despite the challenges of family businesses, business members' involvement plays a significant role in implementing the innovation strategy and its model (Cioca et al., 2020). Innovation can be streamlined smoothly, as the decision-making process is often quick in a family business environment, despite the challenges of business and family relationships. The innovative solution model presented is at a proof-of-concept stage but is evolving. However, regardless of the model and size, leadership plays a significant role in shaping its future development, pushing innovation and creativity to help growth and ensure success despite any challenges.

3. Innovate Process

An innovation process is essential for any business aiming to grow fast; without it, the innovation framework and model become less effective. The innovation process needs a clear development plan with specific milestones from setting goals to launch. This section introduces the entrepreneurial aspects of applying innovative solutions to Anzar Property's business management and operational activities. It aims to introduce a real-life case study about family business challenges during ongoing entrepreneurial activities and property development. This section presents the innovation process and practices applied by Anzar Property Group in their enterprise and entrepreneurial business operations.

The innovation process specifies key methods, procedures, actions, and necessary resources such as AI tools. AI has radically disturbed many industries and sectors, and the real estate sector is not an exception, offering opportunities to and allowing property business entrepreneurs and start-ups to innovate and develop intelligent solutions in a competitive market. Moreover, this disruption brings new opportunities and challenges for entrepreneurs in dealing with AI technologies and establishing their 'smart' businesses. However, innovation might involve adopting a new business strategy or business model to

1. pursue new opportunities for potential growth,
2. address market challenges or
3. satisfy business needs.



Figure 3: Anzar Property Group Innovation Model

AI tools like machine learning can support property developers, professionals, and investors in assessing the property market, evaluating prices, developing projects, planning, and improving the customer experience. Many new tools have redefined the role of real estate businesses, e.g., asset management, buy-to-let companies, and letting agents or estate agents, which will develop and change accordingly due to AI disruptions. Using the innovation model, we created a high-level innovation process to address the above challenges, comprising six critical activities and primary services presented previously.

3.1 Data Analysis and Strategy

Analysing the current property markets and assessing the demand and supply levels in different geographical locations is essential in the real estate business. Property developers and investors must have such analytics and reports to make informed decisions. To achieve that, they can rely on intelligent systems and tools to help them understand the market needs and potential investment opportunities, manage the risks, and then make such vital decisions. AI predictive analytics tools analyse different markets, stay current with market trends, predict market responses to economic events, and detect unusual anomalies. Figure 4 presents a general AI model for analysing property deals available on the market and the appropriate investing areas and strategies. Applying AI mechanisms and learning models can help predict property prices and future changes in market behaviour.

3.2 Finance

Before investing in properties and new development projects, it is essential to ensure the growth and success of the investment through either income generation, acceptable targeted profit margins, and/or capital appreciation. Using intelligent finance tools supported with AI algorithms, offers investors and property brokers different useful tools applicable to digital mortgage brokering, online access to capital, and numerous types of loans. Accessing digital or online mortgage brokering services is becoming vital for property developers and investors, as it provides access to capital and offers different kinds of credit. Moreover, auto search tools for the best suitable mortgage products offer comparison platforms and options for borrowing beyond banks, providing an efficient, transparent mortgage/loan application process that speeds up lending. Furthermore, such intelligent technologies help find and close the best deals faster, eliminating intermediaries and reducing costs.

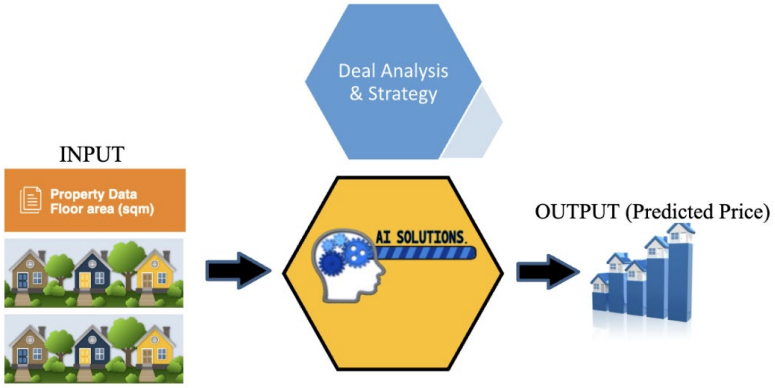


Figure 4: AI Model for Deal Analysis and Business Strategy

3.3 Legal

Managing and processing legal documents such as conveyancing and mortgage reports, loan agreements, and tenancy contracts are essential for any property purchase process. Blockchain technology is a platform capable of processing smart contracts and managing and electronically signing property-related legal documents. It is a decentralised system capable of verifying identities using the personal digital key to authenticate and authorise a smart contract or transaction (Wu, B. and Wu, B., 2023). Using the blockchain and smart contracts can improve the contract management process, speed up the transaction process, ensure transparency, and avoid extra costs. It conducts background checks for all participants to access the innovative contract process and perform secure transactions, reducing the risk of tampering with contract documents, identity theft, or fraud. The blockchain can transfer and record transactions and real estate titles, and perform background checks on all entities involved in a contractual agreement.

3.4 Property Development

Managing the development planning stage and project development life-cycle digitally using innovative tools such as Building Information Modelling (BIM) can streamline property development projects. BIM can simulate the planning and development process and visualise all the milestones of construction projects. Property developers could use innovative simulation tools to design buildings and floor plans, estimate costs, and analyse them before and during construction activities. Moreover, smart buildings can be designed using immersive technologies and 3D design tools and developed and built using 3D printing services supported by data sensors and IoT devices at different construction site locations. This technology can ensure site safety and track people's movements.

A Gen AI application using a GPT model has been developed to help property developers develop appropriate real estate projects, analyse property deals, market assessment, commercial property conversion plans and projects, and cost estimates of such development projects. The developed application is a GPT-based AI-powered property Consultant using ChatGPT to support property investors and professionals with multiple built-in features that can interact with the backend GPT model, analyse the user's input(s), and provide the necessary output(s). The following section details the application prototype and its main features. Figure 5 shows the predefined prompt options and an input field, allowing the application users, such as property investors, to use those prompts and select a specific service or input their own prompt utilising the application’s input field. Figures 6 and 7 present sample outputs of the AI-powered property consultant, showing the planning consideration and proposed conversion layout for residential flats. It offers an option for converting a large office building into multiple smaller flats. The application is designed to help them analyse residential or commercial properties, property locations and markets, and obtain information about converting large properties into multiple smaller flats or houses or both, as follows:

- Analyse any property market using SWOT (Strengths, Weaknesses, Opportunities, and Threats) and PESTEL (Political, Economic, Social, Technological, Environmental, and Legal) analysis.
- Identify supply and demand levels for residential or commercial properties in a specific region or country.
- Get information about commercial property investment opportunities and options.
- Get information about property use classes in the UK and building conversion options.
- Design options for property conversion, such as commercial-to-residential conversion projects.

- Evaluate and optimise the property conversion design process to efficiently use the space, offering cost-effective solutions.

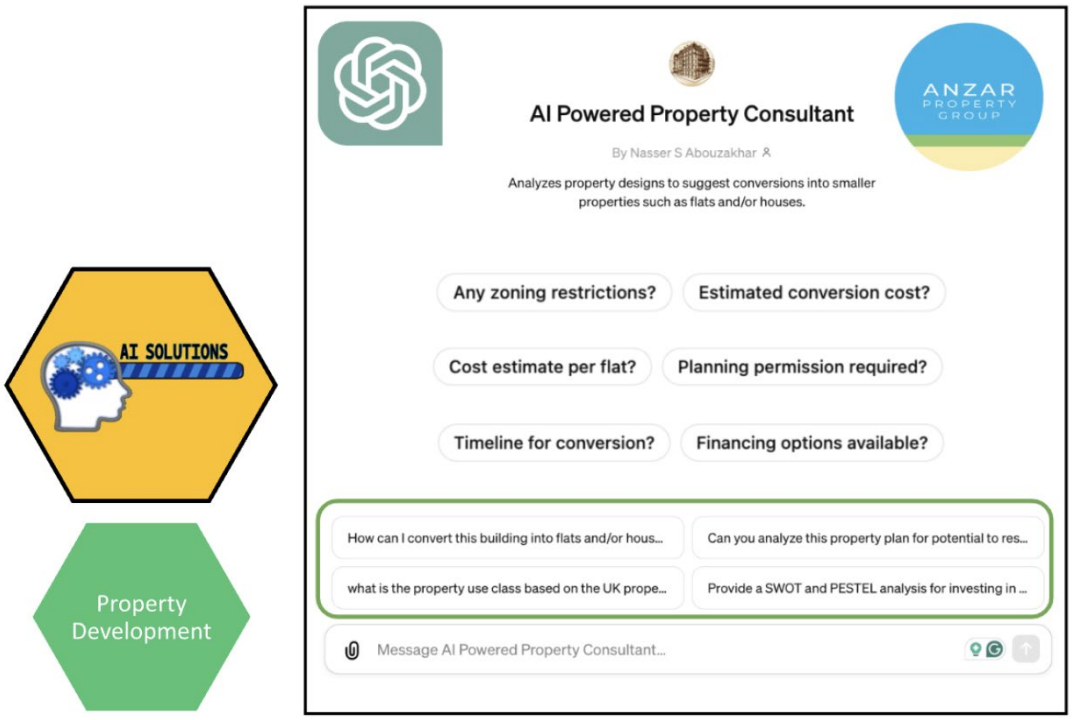


Figure 5: AI-Powered Property Consultant

3.5 Asset Management

Asset management ensures the growth and success of investments through income generation and capital appreciation. At Anzar Property Group, asset management uses various tools to support property and facility managers in carrying out their duties effectively. Asset managers can use AI tools to monitor the performance of property portfolios, stay current with market trends, make critical decisions, and mitigate risk on behalf of investors. This includes two main activities.

- Property Management: Online marketplaces help find potential tenants; with the support of chatbots, unqualified applicants can be identified and filtered, and the same chatbot can preliminarily assess those tenants, and then successful applicants are selected, as shown in Figure 8. Such innovative tools support managers in improving their properties' occupancy rates using cost-effective solutions. Auto-filling tools help prepare tenancy agreements to support property managers in adequately managing their contracts and property portfolios. Autofilling applications use standard templates for tenancy agreements to complete all relevant fields, preparing the contracts for digital signing by the appropriate parties. The tenancy agreement lifecycle is automated via the blockchain to verify all involved parties. The contract can be signed securely online by the letting agent and tenants and recorded in the blockchain. Furthermore, chatbots and online tenancy agreement tools help property managers and potential tenants overcome geographical barriers.

1. Planning and Use Class Considerations

Change of Use: Class E (Office) → Class C3 (Residential)

Under **UK planning law**, converting an office (Use Class **E**) into residential flats (Use Class **C3**) can be done via:

✅ **Permitted Development Rights (PDR)** – If the building qualifies, planning permission may not be required.

✅ **Full Planning Permission** – If significant external changes are needed, such as altering windows or extensions.

Permitted Development (PDR) Key Conditions

🔹 The building **must have been in Class E (office) use on or before 1st September 2020**.

🔹 **Minimum residential unit size**: 37m² (398 ft²) per flat (as per **NDSS - Nationally Described Space Standards**).

🔹 Adequate **natural light** must be available in all habitable rooms.

🔹 **Fire safety compliance** (especially if the building is over **18m high**).

🔹 **Noise insulation** between flats and external noise sources.

🔹 If it's in a **conservation area** or **flood zone**, special permissions may be needed.

Based on the **existing structure**, this office plan is **well-suited** for conversion, as it has:

✅ Multiple separate rooms (offices) that can become bedrooms.

✅ Central corridor access, ideal for dividing into flats.

✅ Existing plumbing (toilets and kitchen areas), reducing major renovation costs.

Figure 6: AI-Powered Property Consultant Output Showing Planning and Use Case Considerations

2. Proposed Residential Conversion Layout

Current Building Dimensions

- **Total Width:** 73 feet (~22.25m)
- **Total Depth:** 45 feet (~13.7m)
- **Existing Rooms:** 10 offices, 2 bathrooms, conference room, snack area.

Proposed Layout: 4 to 6 Flats (Mix of 1-Bed & 2-Bed)

We can reconfigure the space to create **4 to 6 self-contained flats**, ensuring each meets UK **space and building regulations**.

Flat Type	Suggested Layout	Size
Flat 1 (1-Bed)	Bedroom, Living/Kitchen, Bathroom	~42m² (450 ft²)
Flat 2 (1-Bed)	Bedroom, Living/Kitchen, Bathroom	~39m² (420 ft²)
Flat 3 (2-Bed)	2 Bedrooms, Living/Kitchen, Bathroom	~55m² (590 ft²)
Flat 4 (1-Bed)	Bedroom, Living/Kitchen, Bathroom	~37m² (398 ft²)
Flat 5 (Studio or 1-Bed)	Open-plan Living/Sleeping, Kitchen, Bathroom	~35m² (380 ft²)
Flat 6 (Optional)	Small Studio or Storage Area	~30m² (320 ft²)

🔹 **Conference Room (16′ x 12′)** → Can be a **studio flat** or part of a 2-bed unit.

🔹 **Existing Office Spaces (11′ x 21′, 16′ x 11′, 15′ x 11′)** → Ideal for 1-bed flats.

🔹 **Existing Bathrooms (7′ x 6′)** → Can be converted into **en-suite** or shared bathrooms.

Figure 7: The Proposed Conversion Layout for Residential Flats

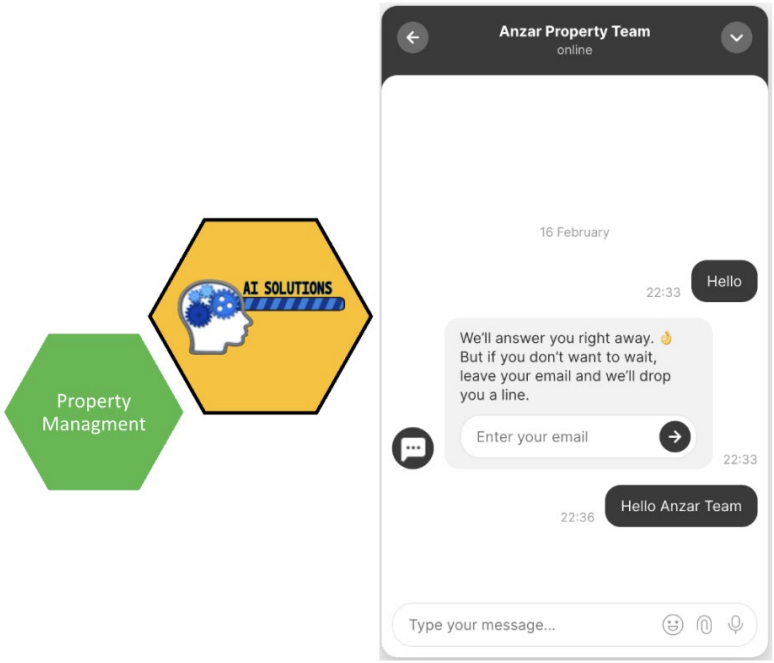


Figure 8: Chatbot

- Facility Management: The facility manager can use smart tools and applications to monitor and optimise efficiency, control costs, assess property usage, and report to the property owner in real-time. This helps to optimise regular checks and routine maintenance, anticipate repairs, and respond to problems and breakdowns in the property. Moreover, it reduces the workload of the facility manager and their maintenance teams, ensuring transparency and better communication to carry out management duties and minimising costs. AI enables buildings to become smarter using sensors and IoT devices, collect data from various essential locations and facilities, and allow facility managers to monitor the performance of their properties remotely. IoT devices are used for real-time data sharing, data transfer, and vital data communication and analysis, as shown in Figure 9. This helps facility managers detect issues in property facilities and apparatus, such as moisture, condensation, or dampness, as early as possible, avoiding damage to property facilities, unnecessary repairs, and additional costs. IoT devices and sensors can offer invaluable support to facility managers in optimising their property facilities and ensuring a quality of service to their tenants.

Our management team will be responsible for developing a strategy for managing this innovation process. Promising ideas are discussed and documented during the weekly board meetings to plan the implementation and actions for monitoring, controlling, and testing activities with proper risk assessment. The management team must ensure the following:

- Leverage family business culture to foster an environment where innovation thrives, and all the management team members are on the same page regarding the innovation strategy.
- Identify innovation and technology trends and understand relationships and interactions within the innovation management process.
- Develop a strategy for implementing the innovation model and workflow, and allocate tasks to those involved at each stage of the innovation process.
- Ensure that critical business systems, processes, and customer services are appropriately managed to positively impact productivity.
- Ensure awareness about ongoing innovation projects and accurate reporting to top management to enhance decision-making.
- Follow through on subsequent steps of the innovation process effectively, ensuring that they are implemented efficiently and effectively using the available resources. This will allow business management to achieve the desired innovation and tangible results for long-term success.

- Review the current innovation framework and model design regularly to help prepare our company for new and unforeseen challenges. Identify innovation case studies, whether online resources or successful stories, to help improve our innovation solution model.

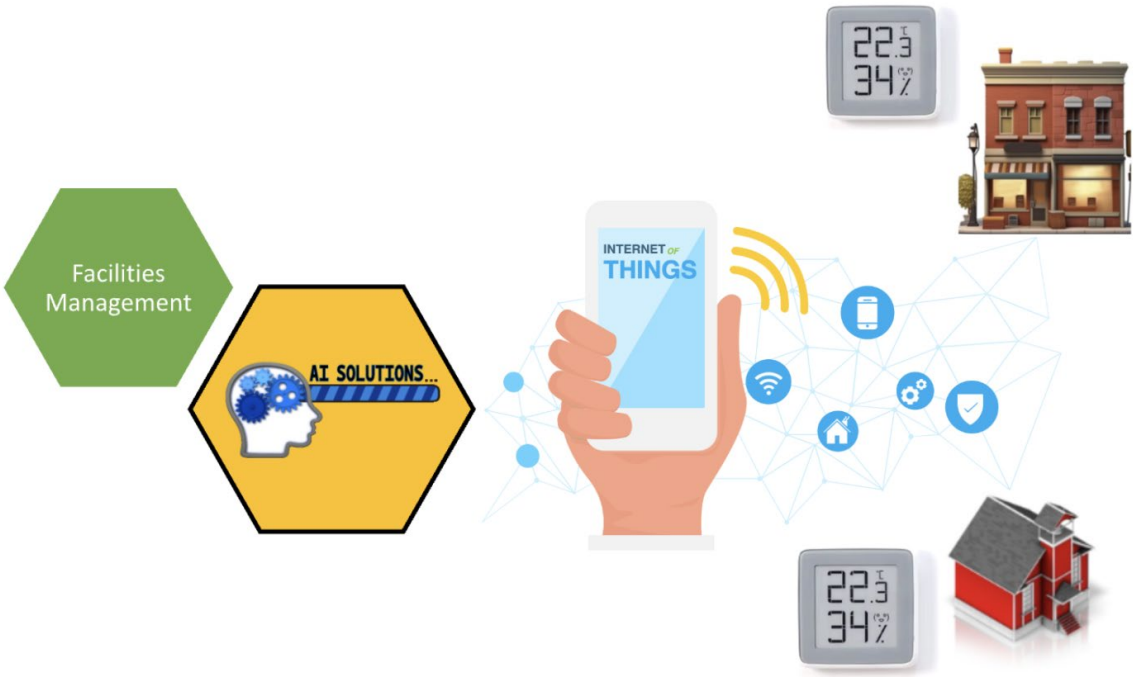


Figure 9: Using IoT Devices for Facility Management

4. Discussion

Innovation can help property SMEs improve their productivity and efficiency using appropriate innovation frameworks and systems. Property businesses can achieve their goals by developing an innovation process with the necessary procedures and taking action. AI technologies are becoming accessible, offering cost-effective innovation solutions for property business managers to support operations and facilities management activities, leading to high returns. Adding value to property portfolios is essential for Anzar Property SME to deliver on time, meet business requirements, and achieve better returns. An innovation framework, system, and growth model have been presented, showing the importance of following a disciplined approach to implement the right tools and deliver consistent results to scale up. An innovation process developed by the Anzar Property Team using various digital and AI technologies was introduced.

Relying on one innovative method is insufficient for long-term progress and sustainability. Innovation is not about using advanced technology only. Still, it can happen at various levels of the 4Ps - process, product, position, and paradigm, using two approaches to innovation: Radical innovation leads to a thorough change in the business strategy or operations, or Incremental innovation implies minor changes to current business practices. Nothing remains fixed forever; business members change, leadership and innovation strategy change, and business members' relationships and responsibilities develop and change. Innovation is a process that needs to be updated to deal with changes in business and innovation strategy, and new challenges appropriately. With the support of necessary tools and systems, this innovation process helped Anzar Property Group improve service quality, deal with business management challenges, and grow.

5. Conclusion

Innovations using AI technologies have opened new avenues for smart activities and cost-effective solutions, saving time and money for start-ups and established enterprises. The paper presented a real-life case study of multiple innovative property tools and facility management solutions. It introduced an AI-based innovation model for a property business comprising six primary services: data analysis and strategy, Finance, Legal, Property Development, Property management, and Facility management. This model was presented as part of the innovation system developed by Anzar Property Group, which includes an innovation process applied in the company’s property business and entrepreneurial operations. An AI-powered Property Consultant application prototype was developed in-house to support property developers, investors, and professionals in developing successful projects using GPT features. The application prototype helps users analyse property markets in

different geographical areas, including demand and supply levels, and offers business opportunities for different development strategies.

The innovation model was developed to support Anzar Property Group in improving the quality of its operations, managing property business processes, and maintaining effective service delivery. Such support is essential for property businesses to minimise costs and ensure service quality. The innovation model plays a significant role in business growth and investment success, staying with market trends and mitigating risks. Implementing the proper innovation process can help property business leaders and managers make informed decisions about property deals, development, and significant property projects, providing cost-effective development projects. With the support of necessary tools and systems, this innovation process helped Anzar Property Group improve service quality, effectively manage its property facilities, deal with business management challenges, and grow.

Ethics declaration

The author did not need ethical clearance for the research referred to in this paper.

AI declaration

The author used OpenAI ChatGPT to develop the AI-powered property consultant prototype shown in Figure 5 and its generated outputs in Figures 6 and 7, which are described in this paper.

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A Comparative Study of Entrepreneurial Intentions in Public and Private Sector Universities: The Moderating Role of Entrepreneurial Education

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Abstract: The primary objective of this research is to study the entrepreneurial intentions of university students in Pakistan, focusing on the moderating role of entrepreneurial education within the framework of the Theory of Planned Behavior (TPB). It is a comparative study of the public and private sector universities, namely Quaid-e-Azam University and Iqra University, to explore how attitudes toward behavior, subjective norms, perceived behavioral control, and entrepreneurial education influence their intentions to pursue entrepreneurship. It a quantitative research study, and the data were collected through surveys questionnaire from 245 final-year students, with a response rate of 62.43%. The hypothesis testing and empirical analysis were performed by SMART PLS and SPSS data analysis software. The findings reveal that attitudes and subjective norms significantly predict entrepreneurial intentions in both institutions, aligning with the TPB. However, entrepreneurial education and perceived behavioral control do not show a direct significant impact on entrepreneurial intentions. Interestingly, the interaction between entrepreneurial education and perceived behavioral control significantly influences entrepreneurial intentions at Quaid-e-Azam University but not at Iqra University, suggesting contextual differences in how education enhances perceived control. The study concludes that while entrepreneurial education alone may not be sufficient to foster entrepreneurial intentions, it can play a crucial role when combined with other factors, particularly in public sector universities. These insights provide valuable implications for policymakers and educators aiming to promote entrepreneurship among university students in developing countries.

Keywords: Entrepreneurial Intentions, Theory of Planned Behavior, Entrepreneurial Education, Comparative Study.

1. Introduction

The idea of entrepreneurship began to take shape during the Middle Ages, as businesses started to evolve toward modern development phases. By the early 20th century, as industrial advancements accelerated in Europe and North America, entrepreneurship began to attract academic attention. Researchers sought to understand the roles entrepreneurs played in innovation, risk-taking, and economic growth. This focus deepened in the late 1980s, when industrialization in both developed and developing nations spurred greater interest in entrepreneurship as an academic field. Scholars began to explore how entrepreneurship could drive local economic development, even in regions with fewer resources.

The research study particularly examines the key factors that shape entrepreneurial intentions among students enrolled in public and private universities across Pakistan. Given the vital role entrepreneurship plays in fostering economic development—through job creation, regional growth, innovation, and enterprise advancement—it is increasingly recognized as a strategic tool for addressing socio-economic challenges (Fietze, 2017). In stark contrast, Pakistan continues to grapple with high unemployment rates, particularly among its youth. According to the report of Pakistan Institute of Development Economics (2021), approximately 31% of young people in the country are unemployed. Alarmingly, 51% of this population comprises women, while 16% are men—many of whom possess professional qualifications. As Apaydin (2018) observed, entrepreneurship has the potential to combat unemployment, given its inverse relationship with joblessness.

The increasing number of graduates produced by universities each year has led to a rising unemployment rate among university graduates, posing a significant challenge for many developing countries (Bagıs et al., 2022). This situation has prompted policymakers and government officials to emphasize the importance of university education and explore ways to integrate recent graduates into the workforce (Che Nawi et al.,

2022). Despite more young people pursuing higher education, many graduates struggle to find jobs due to a disconnect between the labor market and the education system (Draksler and Sirec, 2021). Therefore, guiding new graduates in developing their skills and helping them enter the labor market is crucial for the economic development of these countries (Samydevan et al., 2021).

In many developing nations, there is a pressing need to encourage youth to engage in entrepreneurial activities, offering self-employment opportunities to alleviate unemployment and poverty (Awogbenle and Iwuamadi, 2010). In Pakistan, for example, many students express a strong interest in entrepreneurship as a career choice, believing it offers greater financial rewards. They also show an inclination to engage in entrepreneurial ventures that involve innovation, which is a key characteristic of successful entrepreneurs (Ali et al., 2011). However, despite this interest, Pakistani students exhibit only moderate intentions to pursue entrepreneurship (Tanveer et al., 2013). While the Theory of Planned Behavior (TPB) has been applied in various contexts, it has been less frequently tested in Pakistan (Shabbir et al., 2016). Given the region's high unemployment rate, there is a strong need for empirical research to assess entrepreneurial intentions. Moreover, the decision to pursue entrepreneurship is not only influenced by behavioral factors but is also shaped by entrepreneurial education. This study explores the moderating role of entrepreneurial education in strengthening the relationship between the predictors of entrepreneurial intentions and students' actual intention to become entrepreneurs.

In Pakistan, the higher education landscape is comprised of both public and private sector universities, each offering distinct institutional cultures, resources, and pedagogical approaches. Public universities are often seen as traditional and limited in resources, while private institutions are generally associated with modern infrastructure, stronger industry connections, and a greater emphasis on employability (Hussain, 2018). These institutional differences can significantly impact students' entrepreneurial intentions, as the learning environment, access to resources, and exposure to real-world opportunities all play a crucial role in shaping students' attitudes and aspirations toward entrepreneurship (Rasheed, 2020). Despite these contrasts, there remains a noticeable gap in comparative research exploring how entrepreneurial intentions vary between students from public and private universities in Pakistan. Understanding these dynamics is vital for developing targeted strategies and policies that address the distinct needs of students in both sectors.

Furthermore, the study of entrepreneurial intentions among final-year university students has garnered increasing attention, particularly as these individuals contemplate their future career trajectories—often weighing the choice between traditional employment and entrepreneurial pursuits (Netshilinganedza, 2020). Their decision-making is shaped by a variety of factors, including personal attitudes toward entrepreneurship, prevailing social norms, and their perceived self-efficacy in launching and managing a business (Al-Mamary et al., 2020).

2. Literature Review

2.1 Entrepreneurship

The concept of entrepreneurship dates back to the early 1700s and has been defined and interpreted differently by various scholars, depending on the context and environment (Shane & Venkataraman, 2000). The renowned economist Richard Cantillon described entrepreneurs as individuals who exhibit risk-taking behavior and actively seek out unique opportunities (Coulter, 2003). He further characterized entrepreneurship as a form of self-employment, where individuals buy or create products at current prices with the intention of selling them in the future at uncertain prices, taking on the associated risks. Entrepreneurial scholars generally agree that entrepreneurship plays a crucial role in driving economic growth. By fostering innovative ideas, improving systems, and introducing value-added products and services, entrepreneurship creates new economic opportunities. Its positive impact extends not only to individuals but also to societies, nations, and even entire regions (GEM, 2005).

2.2 Entrepreneurial Intentions

Remeikiene and Startiene (2013) defined entrepreneurial intention as a mental state that motivates individuals to identify new business opportunities or innovations within existing businesses. It is essentially the initial phase of the decision-making process when considering the creation of a new business (Bird, 1988), and is often used to predict future entrepreneurial behavior. Bird (1988) further explained that intention is a specific feeling that arises from practical experiences and environmental influences. However,

Ajzen (1991) contended that the intention to start a new business typically stems from prior planning and consideration.

2.3 Theories of Entrepreneurial Intentions

Several theories on entrepreneurial intentions have been proposed by researchers, including the Self-Determination Theory (SDT), Social Cognitive Theory (SCT), and the Theory of Planned Behavior (TPB), each offering valuable insights into the factors influencing entrepreneurial intentions by emphasizing internal motivation and cognitive processes (Permana et al., 2024). SDT suggests that autonomy, competence, and relatedness are key drivers of intrinsic motivation, which plays a crucial role in entrepreneurship (Chen et al., 2020). On the other hand, SCT focuses on self-efficacy and observational learning as essential factors in shaping entrepreneurial behavior (Nwosu et al., 2022). Among these, the TPB has emerged as a widely recognized and effective framework for predicting entrepreneurial intentions, often considered more comprehensive than SDT and SCT.

2.4 Theory of Planned Behavior

The Theory of Planned behavior TPB derived from the Theory of reasoned Action. (Su, et al. (2021). Although several studies have applied TPB to examine entrepreneurial intentions among university students. (Al-Jubari et al., 2019), posits that human behavior is driven by intentions and the perceived control over that behavior. The Entrepreneurial intentions refers to a person's internal belief and deliberate commitment to establish a new business in the future. Moreover, the entrepreneurial intentions play a central role in starting a new business (Shahzad et al., 2021).

Intentions are shaped by three primary factors Attitude towards behavior refer to the individual's positive or negative evaluation of behavior (Zhang, et al., 2019). While Subjective norms reflect the approval or disapproval of significant others. Bazan, (2022); explain that perceived behavioral control indicates the ease or difficulty one associates with performing the behavior, which is influence by the confidence in their abilities.

2.5 Attitude Towards Behavior

According to Shane and Venkataraman (2000), entrepreneurship is a field of study that focuses on how individuals identify opportunities to discover both explicit and implicit goods and services, while also evaluating and exploring the resources required. The entrepreneur's perception plays a crucial role in realizing future opportunities and benefits. Attitudes are shaped by the beliefs individuals hold when engaging in specific behaviors (Ajzen, 2005). According to Ajzen and Fishbein (2005), the outcomes of a behavior are influenced by behavioral beliefs, which include the expected advantages and costs associated with that behavior. Recent studies Ali et al., (2024), and Martins et al., (2023) have also examined how implicit beliefs and perceived outcomes related to entrepreneurship affect the intention to start a new business. Personal benefits gained from entrepreneurial ventures are key drivers of entrepreneurial intentions (Volery et al., 2013).

2.6 Subjective Norms

According to Ajzen (2005), subjective norms refer to the social influences individuals perceive from society, which play a crucial role in determining whether or not they engage in specific behaviors. These influences come from significant individuals such as family members, relatives, coworkers, colleagues, peers, and sometimes even experts in the relevant field. People tend to feel compelled to perform behaviors that are expected or approved by their social group and often experience social pressure to act in ways that align with these expectations. Building on Ajzen's work, Lapista et al. (2012) and other recent studies have found that individuals are more likely to pursue entrepreneurial ventures that are already supported or practiced by their entrepreneurial contacts. The importance of subjective norms in shaping intentions to start new businesses has been further validated by research from Engle et al. (2010).

2.7 Perceived Behavioral Control

Perceived behavioral control refers to an individual's personal assessment of their ability to perform a specific behavior. According to Ajzen and Cote (2008), it arises from control beliefs about the availability of

factors that may either facilitate or hinder the performance of that behavior. Ajzen (2011, 2012) further explains that internal and external factors—such as access to resources, opportunities, knowledge, skills, responsibilities, personal experiences, information, and the past experiences of others—can influence an individual's perception of how difficult or easy it is to engage in a particular behavior. Linan et al. (2013) noted that individuals are more likely to feel motivated and confident in pursuing entrepreneurial activities when their decisions are acknowledged, appreciated, and valued by others in their community. Both the social and internal environments play a crucial role in shaping a positive perception of entrepreneurship, which in turn affects perceived behavioral control.

2.8 Entrepreneurial Education

Several studies have integrated a major education variable into research models in order to explore entrepreneurial intentions such as (Karhunen and Ledyaeva, 2010; Lin˜an and Chen, 2009). Having majored in business education was often a significant variable explaining entrepreneurial intentions. From an educational perspective, universities play a crucial role by designing programs and experiences that foster entrepreneurial attitudes and skills and boost entrepreneurial spirit among students (Badawi, 2024). Entrepreneurial education is a vital factor influencing the entrepreneurial intentions of university students, as it facilitates the development of entrepreneurial abilities and promotes behaviors that encourage students to establish their own business. (Su et al., 2021).

Empirical studies have shown that entrepreneurial education and training positively influence entrepreneurial intentions by stimulating creative ideas, fostering entrepreneurial behaviors and enhancing performance (Lv et al., 2021). The impact of EE on entrepreneurial intentions varies across contexts, studies highlight positive relationship between EE and EI ,such as attitudes and PBC.(Huang et al., 2024).Conversely, others report mixed or insignificant findings (Nayak et al., 2024).These inconsistencies suggest that EE's influence may extend beyond direct effects, interacting with other variables, such as SN and gender, to shape entrepreneurial behavior, EE may create attitudes and reducing gender-based stereotypes that portray entrepreneurships as a male dominated career path. (Gupta et al., 2019).

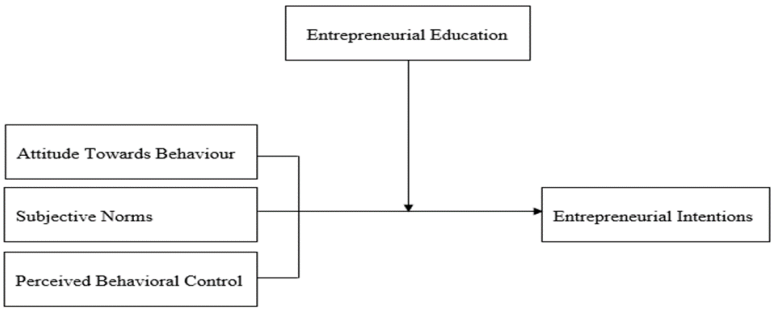


Figure 1: Conceptual Framework of the Research Study

3. Research Hypothesis

H1: Attitude Towards Behaviour positively & significantly affect entrepreneurial intentions of the university students.

H2: Subjective Norms positively & significantly affect entrepreneurial intentions of the university students.

H3: Perceived Behaviour Control positively & significantly affect entrepreneurial intentions of the university students.

H4,5,6: Entrepreneurial Education moderate the relationship between ATB, SN, PBC & entrepreneurial intentions of the university students.

4. Research Methodology

This study employed a quantitative research design with particular focus on the Theory of Planned Behavior (TPB) and the moderating role of entrepreneurial education. The research was guided by the following core objectives: (1) to identify the key factors influencing the entrepreneurial intentions of students from public and private sector universities in Pakistan, (2) to examine the impact of Attitude Towards Behavior, Subjective

Norms, and Perceived Behavioral Control on entrepreneurial intentions, and (3) to investigate the moderating effect of entrepreneurial education on the relationship between these TPB constructs and entrepreneurial intentions.

Pakistan's higher education system, comprises over 200 universities including public and private institutions, the selection of Quaid-i-Azam University (QAU) and Iqra University Islamabad provides a meaningful representation of both sectors. QAU, (QS World ranking) being a leading public sector research-intensive university ranked among the top in the country, represents govt-funded institutions with a merit & quota based admission system and diverse student demographics from across Pakistan. Similarly, Iqra University a prominent private sector institution (HEC), is known for its market-driven academic programs and entrepreneurial orientation. By selecting one university from each sector located in the federal capital, we capture variations in institutional governance, student socioeconomic background, and exposure to entrepreneurial education. We acknowledged that this research population may not fully represent all universities in Pakistan, however, it offers a theoretically relevant contrast that reflects key differences in Pakistan's private and public sector education system.

Hence, the survey data were collected from the School of Management Sciences, Quaid-e-Azam University (public sector) and Department of Business Administration, Iqra University (private sector). This study's data was collected during March and April 2025. Participants were final-year students enrolled in the Spring 2025 semester at Quaid-e-Azam University and Iqra University. The final year students were selected for the population of this study due to the appropriateness of the research study Liñan, & Chen (2009). The study's purpose was thoroughly explained to participants before they completed the survey. The survey questionnaires of theory of planned behaviour were adopted from the previous study of (Irene et al., 2017) and the entrepreneurial education were adopted from the previous research paper of Anwar et al., (2020). The total number of the final year's students of Quaid-e-Azam university is 200 and Iqra University Islamabad is 123. Out of the 245 questionnaires distributed, 43 were excluded due to improper completion, not return and unanswered. As recommended by Byrne (2013) minimum 50% response were enough for the data analysis. Furthermore, given the exploratory nature of this study, Smart PLS-SEM was applied for data analysis, consistent with the methodological guidelines suggested by (Zeb et al., 2020).

5. Data Analysis and Discussion

5.1 Demographic Variables

The demographic profiles of participants from both Quaid-e-Azam University and Iqra University are presented in the table below, detailing key characteristics along with their respective frequencies and percentages. The analysis examines six demographic variables: gender distribution, age ranges, academic programs, current semester of study, institutional affiliation, and paternal occupation.

Table 1: Demographic profile of the respondents

Attributes	Quaid-e-Azam University		Iqra University	
	Frequency	Percentage	Frequency	Percentage
Gender				
Male	85	61.59%	47	73.44%
Female	51	36.96%	17	26.56%
Transgender	2	1.45%	0	0.0%
Age				
21-25	128	92.75%	62	96.88%
26-30	8	5.80%	1	1.56%
31 & above	2	1.45%	1	1.56%
Program				
BBA	127	92.03%	63	98.44%

Attributes	Quaid-e-Azam University		Iqra University	
	Frequency	Percentage	Frequency	Percentage
MBA	11	7.97%	1	1.56%
Semester				
Second last	4	2.90%	0	0.0%
Last semester	134	97.10%	64	100%
Father's Occupation				
Government job	68	49.28%	18	28.12%
Private job	18	13.04%	15	23.44%
Own business	42	30.43%	27	42.19%
Agricultural work	10	7.25%	4	6.25%

At Quaid-e-Azam University, male respondents accounted for 61.59%, whereas at Iqra University, this figure was higher at 73.44%. Female participation was greater at Quaid-e-Azam University (36.96%) compared to Iqra University (26.56%). The absence of transgender respondents at Iqra University compared to the 1.45% at Quaid-e-Azam University could be attributed to differences in campus culture and inclusivity. Most respondents at both universities were aged between 21–25, with 92.75% at Quaid-e-Azam University and 96.88% at Iqra University, highlighting the sample's focus on final-year students. A small number of respondents from older age groups (26–30 and 31 & above) were represented, suggesting limited enrollment of mature students in these programs.

The majority of respondents at both universities were enrolled in the BBA program, with 92.03% at Quaid-e-Azam University and an even higher 98.44% at Iqra University. MBA students formed a small minority at both universities, with more representation at Quaid-e-Azam University (7.97%) than at Iqra University (1.56%). Nearly all respondents were in their final semester, with 97.10% at Quaid-e-Azam University and 100% at Iqra University. At Quaid-e-Azam University, 49.28% of respondents reported their fathers held government jobs, compared to 28.12% at Iqra University. Conversely, a higher percentage of respondents at Iqra University (42.19%) reported their fathers were engaged in private businesses, compared to 30.43% at Quaid-e-Azam University. This reflects a stronger entrepreneurial culture among families associated with private institutions.

5.2 Measurement Model

The measurement model assesses the relationships between observed indicators and latent constructs. To ensure the validity and reliability of the constructs, both convergent and discriminant validity were tested. Convergent validity was demonstrated by high factor loadings, Composite Reliability (C.R) values exceeding 0.7, and Average Variance Extracted (AVE) values greater than 0.5. Discriminant validity was confirmed using the Fornell-Larcker criterion and the Heterotrait-Monotrait ratio (HTMT), ensuring constructs are distinct and not overly correlated with one another.

Table 2: Results of the measurement model

Constructs	Items	Factor Loadings	Alpha Value	AVE	C.R
Attitude Towards Behavior			0.833	0.621	0.876
	ATB1	0.788			
	ATB2	0.862			
	ATB3	0.543			
	ATB4	0.791			
Subjective Norms			0.732	0.598	0.834
	SN1	0.697			
	SN2	0.265			

Constructs	Items	Factor Loadings	Alpha Value	AVE	C.R
	SN3	0.814			
	SN4	0.583			
Perceived Behavioral Control			0.791	0.616	0.856
	PBC1	0.659			
	PBC2	0.698			
	PBC3	0.526			
	PBC4	0.589			
	PBC5	0.638			
	PBC6	0.760			
Entrepreneurial Intention			0.843	0.701	0.891
	EI1	0.840			
	EI2	0.848			
	EI3	0.717			
	EI4	0.761			
	EI5	0.772			
Entrepreneurial Education			0.865	0.684	0.890
	EE1	0.802			
	EE2	0.748			
	EE3	0.739			
	EE4	0.754			

The factor loadings indicate how strongly each item correlates with its respective construct, with values ≥0.5 considered acceptable but ideally ≥0.7 for stronger validity. In this study, SN2 (0.265) has weak loading, suggesting it doesn't properly measure the constructs, hence construct SN2 is deleted from the above analysis, while PBC3 (0.526) and PBC4 (0.589) are borderline. The Cronbach's Alpha values (0.732–0.865) exceed the 0.7 threshold, confirming strong internal consistency for all constructs. Additionally, the Average Variance Extracted values (0.598–0.701) meet the ≥0.5 benchmark, demonstrating adequate convergent validity, and the Composite Reliability scores (0.834–0.891) further validate the constructs' robustness. Overall, while most constructs are reliable, certain item (particularly in SN2) require refinement to enhance measurement accuracy.

5.3 Discriminant Validity

The discriminant validity criteria set by Fornell and Larcker is wide used in research studies to assess the discriminant validity (Hamid et al., 2017). The method introduced by Fornell and Larcker evaluates the square root of average variance extracted (AVE) with the correlation of the latent constructs. Hair et al. (2014) stated that the positive square root of AVE values of each construct should be higher than the correlation of other constructs. The result of the Fornell-Larcker criterion is presented in Table below.

Table 3: Fornell-Larcker criterion

	1	2	3	4
ATB	**0.800**			
IE	0.050	**0.228**		
PBC	0.113	0.202	**0.195**	
SN	-0.069	0.172	0.169	**0.147**

The above results represent the square root of variance extracted (AVE) of each construct with bold diagonal values. In contrast, correlation among latent constructs is shown in off-diagonal columns and rows with an un-bold value in the table. All the AVE values of research study constructs and their respective square root were more significant than the correlations among other constructs, respectively. Hence, this study found and validated discriminant validity among the research constructs.

5.4 Coefficient of Determination (R^2)

The coefficient of determination, commonly known as R^2 helps quantify the proportion of variation in the dependent variable explained by the independent variables. According to Hair et al. (2011), R^2 plays a key role in determining the significance of the model's path coefficients. The primary aim of R^2 is to assess how well the independent variables predict the dependent variable (Hair et al., 2011). In the current study, R^2 values for the variables under investigation are displayed in Table. These values indicate the extent of variability explained by the independent and moderating variables in the model.

Table 4: Coefficient of determination (R2)

Constructs	R^2 Value Iqra University	R^2 Value Quaid Azam University
Attitude towards behaviour	0.666	0.625
Subjective norms		
Perceived behavioral control		
Entrepreneurial Education		

Cohen et al., (1989) highlighted desirable ranges for R^2, values of 0.26, 0.13, and 0.02 are considered strong, moderate, and weak, respectively. The present study examines several independent variables—attitude toward behavior, subjective norms, perceived behavioral control along with moderating variable of entrepreneurial education. The dependent variable, entrepreneurial intentions, demonstrates an R^2 value of 0.666, which falls within an acceptable range. The R^2 value of 0.666 indicates a strong explanatory power of the independent variables on the dependent variable, highlighting the significant role of these predictors in shaping entrepreneurial intentions.

5.5 Path Analysis

The results of the path analysis explained the correlation among the independent, moderation and dependent variables. Moreover, the hypothesis acceptance or rejection decision can be made based on the path coefficient analysis of the structural model. The results of the structural path analysis are presented in table below. The path coefficient described the hypothesized correlation of the constructs; as suggested by Hair *et al*., (2014) the range of values are -1 to +1. Similarly, it further explained the most influencing factor like closer to +1 shows a strong correlation, and closer to -1 shows vice versa.

Table 5: Path Analysis

Variables	P-values Iqra University	Decisions	P-Values Quaid Azam University	Decisions
ATB -> EI	0.000	Supported	0.000	Supported
EE -> EI	0.883	Not Supported	0.746	Not Supported
PBC -> EI	0.328	Not Supported	0.414	Not Supported
SN -> EI	0.017	Supported	0.000	Supported
EE x ATB -> EI	0.362	Not Supported	0.142	Not Supported
EE x SN -> EI	0.326	Not Supported	0.642	Not Supported
EE x PBC -> EI	0.186	Not Supported	0.016	Supported

The results indicate that ATB significantly influences entrepreneurial intention in both universities, with p-values of 0.000, suggesting that students with a positive attitude toward entrepreneurship are more likely to develop entrepreneurial intentions. This finding aligns with Ajzen's (1991) Theory of Planned Behavior (TPB), which posits that attitude is a strong predictor of intention. Similarly, subjective norms (SN) also significantly impact EI in both institutions, with p-values of 0.017 (Iqra University) and 0.000 (Quaid Azam University). These results confirm previous studies (Krueger et al., 2000) that highlight the role of social influence in shaping entrepreneurial intentions.

On the other hand, entrepreneurial education (EE) does not directly influence EI in either university, as indicated by high p-values (0.883) at Iqra University and (0.746) at Quaid Azam University. This contradicts some prior research that emphasizes EE as a key driver of entrepreneurship (Nabi et al., 2017). Similarly, perceived behavioral control (PBC) does not show a significant relationship with EI, as p-values remain above 0.3 in both universities, contradicting TPB, which suggests that self-efficacy and perceived control play a crucial role in entrepreneurial decision-making (Ajzen, 2002).

The interaction effects of EE with ATB and SN are also found to be insignificant for both institutions, further emphasizing that entrepreneurial education alone may not be enough to foster entrepreneurial intentions. However, a key finding is that EE × PBC significantly affects EI at Quaid Azam University ($p = 0.016$), while it remains insignificant at Iqra University ($p = 0.186$). This suggests that entrepreneurial education enhances the effect of PBC on entrepreneurial intention at Quaid Azam University.

6. Discussion

This study, motivated by identified gaps in the existing literature, aimed to explore the factors influencing entrepreneurial intentions (EI) among university students in Pakistan, focusing on Quaid-i-Azam University and Iqra University in Islamabad. A comparative research model, adapted from González-Serrano et al. (2021), was used to examine these dynamics. The findings present a compelling narrative that contrasts with previous studies, such as those involving Malaysian students (Ali et al., 2023), and emphasize the unique socio-cultural context of Islamabad's academic environment.

The results show that both ATB and SN significantly influence EI at both Iqra and Quaid-i-Azam Universities. This supports the TPB, indicating that students with positive attitudes towards entrepreneurship and those who perceive strong social support are more likely to develop entrepreneurial intentions. However, the influence of PBC was more complex. While PBC generally had a significant effect on EI among Pakistani university students, the strength of this relationship varied slightly between the two universities, suggesting that students at each institution perceive their control over entrepreneurial outcomes differently.

Contrary to some expectations, EE did not significantly moderate the relationships between ATB, SN, and EI at either university. This suggests that, within these contexts, entrepreneurial education alone does not substantially enhance the influence of attitudes or social norms on entrepreneurial intentions. However, a significant divergence was observed in the interaction between EE and PBC. Specifically, at Quaid-i-Azam University, EE significantly moderated the relationship between PBC and EI, suggesting that entrepreneurial education strengthens the effect of perceived control on entrepreneurial intentions within that particular academic environment. This moderating effect was not seen at Iqra University, indicating that the impact of entrepreneurial education on perceived control and, consequently, on entrepreneurial intentions, differs significantly between the two institutions.

7. Conclusions

This study provides a comparative analysis of the determinants of entrepreneurial intentions among students at Iqra University and Quaid-i-Azam University, Islamabad, through the lens of the TPB and the moderating role of entrepreneurial education. The coefficient of determination (R^2) values 0.666 for Iqra University and 0.625 for Quaid-i-Azam University indicate strong explanatory power, suggesting that the selected constructs meaningfully explain the variance in entrepreneurial intentions. The structural path analysis reinforces the centrality of attitude toward behavior and subjective norms in shaping entrepreneurial intentions in both institutions. Conversely, perceived behavioral control and entrepreneurial education did not show significant direct effects on EI in either university. These results challenge traditional TPB expectations and question the universal applicability of EE as a driver of entrepreneurial motivation in the Pakistani academic context.

These results suggest that entrepreneurial education, as currently implemented, may not sufficiently amplify the influence of students' attitudes or perceived social expectations on their entrepreneurial intent. This comparative investigation contributes valuable insights into the dynamics of entrepreneurial intentions and highlights the limitations of educational interventions in their current form. The findings offer actionable implications for policymakers, educators, and university administrators seeking to cultivate entrepreneurial ecosystems within academic institutions. Moreover, policymakers should provide subsidies for entrepreneurial business projects. This will further motivate the students towards self-employment. Subsequently, the subjective norms will be enhanced and improved in the students. Finally, this will further accelerate and positively influence other variables. Similarly, the psychological aspects are also important for entrepreneurship

so government formulate socially acceptable and attractive policies to entrepreneurial intentions among the students.

Nonetheless, the study is not without its limitations. The use of non-random sampling and the exclusive focus on two universities students restrict the generalizability of the results to broader populations. Future research, particularly longitudinal studies, would be beneficial in capturing how entrepreneurial intentions evolve over time and translate into entrepreneurial action. It should also include other provincial level public and private sector universities. Despite these limitations, the study meets academic research standards and enriches the existing body of knowledge on entrepreneurship in the context of developing economies.

Ethics Declaration

This research did not require ethical approval as it did not involve any secret human participants, personal data collection, or sensitive information. All the sources and examples cited in this paper are publicly available and properly referenced/cited.

AI Declaration

AI tools, such as Google Gemmini and DeepSeek, were used to assist in refining academic language, and organizing the structure of the manuscript. All content generated by AI was critically reviewed, edited, and verified by the author(s) to ensure accuracy, originality, and adherence to scholarly standards. However, this manuscript similarity index was checked using plagiarism detection software and found to be within the acceptable range, indicating proper academic integrity and originality.

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Forming B2B Sales Strategies: Digital Challenges, Mutual Benefits and Supportive Partnerships Establishment

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Abstract: Digitalisation has changed the way businesses operate, including the part of Business-to-Business (B2B) sales. The rapid pace of digitalisation has sparked a surge of research interest. However, much of the research into the relationship between digitalisation and B2B sales to date, has focused on short-term tactics. Consequently, there exists a lack of in-depth research on sales strategies in combination with the balance of mutual benefits, along with relevant corporate partnerships, that generally encompasses supporting the deployment of the transacting enterprises within digital environment. Because of these research gaps, the current primary research addresses two major issues. Firstly, it seeks to examine the dynamics of digitalisation in formulating B2B sales strategies. The second aspect concerns examination of the balance of mutual stakes and support partnerships of B2Bs with regard to the digital field. Empirically, fourteen qualitative, semi-structured in-depth interviews with B2B owners and relevant executives were conducted. The research revealed that the digital environment has formulated B2B sales strategies on a new basis and simultaneously developed the state of mutual benefits and developed cooperation as well. Additionally, it enhances the competitive status and contributes to meeting challenges occurred in the business sector. On top of that, it creates value in a transparent way and creates a trustful relationship among businesses. In this regard, reciprocity of interest in trade transactions suggest satisfaction and reinforces the competitive advantage. However, due to the fact the digital transition is not equally well developed in all countries and businesses, a digital divide is being established that needs to be addressed more by relevant policies in order for the latter to support the weaker parties. Moreover, the findings of the research are both theoretically and practically intriguing, wherein they add evidence to the hitherto narrow focus of research into digital era and B2B sales strategies on long term tactics. Simultaneously, the findings could help shape relevant policies to further support entrepreneurship at international, national, regional and local level, especially those entrepreneurs involved in the B2B area.

Keywords: B2B, Enterprises, Digitalisation, Sales Strategies

1. Introduction

Digitalisation has caused major changes in economic activities creating opportunities but also challenges for businesses including Business-to-Business (B2B) (Rodríguez et al, 2024; Ritter & Pedersen, 2020). According to Miller (2012) the term B2B refers to the process of commercial interaction among businesses. It is evident that digitalisation has certainly created opportunities for B2B firms, and at the same time raised questions about business' ability to employ digital strategies (Chirumalla et al, 2018; Siamagka et al, 2015). Trade personalization as well as international business transactions are continuously expanding whilst this fact accelerates knowledge transfer (Skare et al, 2023; Makris & Apostolopoulos, 2021) that negatively affects several B2B enterprises in countries with a digital deficit (Harrison et al, 2017).

This study responds to the rapidly developing world of digitalization and its impact on businesses with a focus on digitalization in the sphere of B2B in Greece. This contextual setting is novel and should offer valuable insights for those wanting to understand the complexities underlying the issue of digitalisation's impact on business. Because the study's approach is inductive, we do not test a specific theory but let relevant themes emerge from our data; the literature review serves to provide an overview of the field, rather than set up a theory/hypotheses to be tested. This type of deductive research may appear once the area is better understood.

2. Literature Review

Despite the increased use of digitalization in business, it is still something many business are only just beginning to fully engage with. Similarly, the benefits of digitalization and also potential downsides are still the subject of much research, not least in the underseved area of B2B. Herhausen et al, (2020) suggested two gaps define a

digital deficit. The first concerns knowledge and the other practice. At the same time, research has shown that usage of digital technologies creates an integrated and targeted communication that contributes to customer retention while building deeper relationships of trust, mutual interests and further support (Royle & Laing, 2014; Wymbs, 2011). Moreover, according to Mulhern (2009), digitalisation constitutes also a significant change in the history of communications. At a time when sales in B2B markets require complex solutions to differentiate from competitors, digitalisation is the answer to increase efficiency and revenue (Rodríguez et al, 2020). This is why digitalisation is increasingly seen as a source of competitive advantage in the complex sales environment and in B2B firms (Leeflang et al, 2014; Andzulis et al, 2012).

Simultaneously, research has shown that the use of digital technologies creates an integrated and targeted communication that contributes to customer retention while building deeper relationships of trust, mutual interests and mutual support (Royle & Laing, 2014; Wymbs, 2011). Moreover, according to Mulhern (2009), digitalisation represents a phase change in the history of communications

According to Rodríguez et al, (2020) in order to effectively advance digitalisation in the B2B sales process, it is necessary to align the value of people with the goals of the B2B business and at the same time to acquire digital skills. At the same time in the digital environment of B2B firms, relationship value is a factor with a positive effect on trust, commitment and supplier satisfaction (Gil-Saura et al, 2009). In the complex B2B sales process, digitalisation is not without obstacles since according to the research of Rodríguez et al, (2020) objective information is related to digitalisation while subjective information is related to analog information. Although the benefits of B2B digitalisation have been captured in various studies (Van den Steen et al, 2020; Yao et al, 2009) the bilateral nature of the transactions (Apostolopoulos et al, 2022a; Bryan, 2018) and how the balance of mutual interests is shaped (Agoraki et al, 2024; Royle & Laing, 2014) is of particular importance. This research aims to fill the gap by examining how within the digital context of B2B firms sales strategies are shaped in conjunction with the balance of mutual interests and mutual support partnerships between suppliers and sellers.

Furthermore, further gaps exist in our knowledge surrounding the adoption of digitalization in the B2B domain. B2B research to date has examined aspects of digitalisation on the basis of short-term tactics and on the impact of digital technologies without delving into the strategies and alignment of digitalisation among transacting members of B2B firms in conjunction with sales strategies (Van den Steen et al., 2020). Lilien's (2016) study showed the research deficit that exists in B2B firms. Even with a similar economic transaction weight as B2B and B2C (business-to-consumer) firms there is an imbalance of academic research at the expense of B2B (Skare et al, 2023; Reid & Plank, 2000). It is noted that little research evidence exists on which specific digital technologies businesses use in transactions as well as misalignments in transactional parties (Van den Steen et al, 2020). However, other research has shown the great potential of digitalisation in B2B in terms of low transaction costs, transparency, information, efficiency, overcoming bureaucracy, easy access to customers, low marketing costs and increased sales (Shree et al, 2021; Loukis et al, 2011; Wang et al, 2008). Research by Cartwright et al, (2021) indicated that social media should be used in a strategic way rather than just as a simple tool. Reviewing the literature, it is found that digitalisation in the context of B2B is an emerging research area that needs more focus from scholars (Shree et al., 2021; Chakravarty et al., 2014).

In sum, the literature review has established that digitalization holds much promise for firms, but these cannot be taken for granted. Concerns persist surrounding digitalisation's ability to foster mutually beneficial, trusting relationships, although some research exists that suggests digitalization is in no way inferior to in-person relationships in this regard. With much research focusing on the ability of digitalization to smooth the wheels of business, there is still very limited empirical evidence of this within the B2B domain, and certainly not within a Greek context. This study therefore addresses this gap, providing some initial insights which may then, tentatively be compared to studies in other international contexts.

3. Methodology

Empirically, a qualitative research approach was chosen since according to the literature it is effective in detecting and evaluating human views and experiences and at the same time it reliably clarifies and interprets economic and business environments (Neergaard & Ulhøi, 2007; Denzin & Lincoln, 1996). Data were collected from a sample of fourteen entrepreneurs and business executives via individual semi-structured interviews. Interviews were chosen as they have the potential to better approximate business environments with objectivity and reliability (Creswell & Poth, 2016; Lincoln & Guba, 1985), providing more detailed insights than would typically be available via a survey. As the study was also not testing a theory the use of a more inductive

approach, scoping themes rather than testing hypotheses, interviews were seen as preferable. Participants came from different regions of Greece as illustrated in Map 1.



Figure 1: The selected sample regions

To identify B2B we used the Convenience Sampling strategy which as a strategy is common in qualitative entrepreneurship research (Moser & Korstjens, 2018). Since most of the active businesses consists of SMEs in Greece, inherently, the sample featured family businesses as well as micro-enterprises from different sectors. In this light, the sample size was such that it did not distort individual characteristics and was based on the principles of relevance and adequacy (Polit and Hungler, 1999). More specifically, based on the international literature regarding qualitative approaches, the sample size in such occasions should be small so that each case has a distinct narrative (Robinson, 2014). In this light, relatively small sample size allowed us to conduct in-depth interviews and not lose focus of the subjective and individualised characteristics (Smith, 2022) of our examined entrepreneurs. Future emprirical research could utilize certain comparisons among demographics such as gender, digital literacy, years in position.

Table 1: Captures the characteristics of the selected firms

Respondent	Year of Establishment	Status	Employees	Region
R1	1969	Beverage products	630	Attica
R2	1969	Standard food products	430	Peloponnisos
R3	2018	Jewelery	3	Crete
R4	2022	Jewelery	6	Attica
R5	1998	Wine sales	14	Peloponnisos
R6	1975	Jewelery	10	Attica
R7	1950	Food	70	Thesalia

Respondent	Year of Establishment	Status	Employees	Region
R8	1962	Traditional olive oil, olives and dried figs of Kalamata	90	Peloponnisos
R9	1958	Dairy products	15	Ipirou
R10	2019	Automotive trading	4	Attica
R11	1994	Pharmaceutical products	102	Peloponnisos
R12	1968	Packaged olive kernel carbon	10	Peloponnisos
R13	1988	Optical items	15	Cental Macedonia
R14	2001	Dental materials	8	East Macedonia & Thraki

The duration of each interview was approximately forty minutes. The interviews were conducted in September and October 2024. The telephone and the internet were used for the interviews. It should be noted that data collection from interviews using on line meetings / calls, according to the international literature, appreas to be as reliable as face-to-face / in person interviews (Deakin & Wakefield, 2014; Cachia & Millward, 2011). Utilising the aforementioned inductive approach, themes emerged from the interviews in the course of data analysis (Gioia et al., 2013). Cross-checks were made against the themes (Yin, 1994). Table 2 captures the relevant themes and sub-themes

Table 2: Content analysis

Theme	Sub-theme
Digital challenges and influence	• Importance of online channels • Digital challenges • Digital influences • Improving competitive position
Characteristics of options and formulation of strategies	• Business characteristics • Determining factors • Performance assessments • Shaping of behaviours • Data management and protection
Mutual interests and mutually supportive partnerships	• Digital transactions and partnerships • Communication and relationship building • Interactions • Mutual interests

4. Findings

The research findings were separated into three thematic categories. Category one included the findings concerning the digital challenges and the implications involving B2B businesses. Category two included the findings that related to choice making and strategy formation. Category three incorporated findings on balance of mutual interests and sellers'/suppliers' partnership support, as far as B2B businesses are concerned.

4.1 Digital Challenges and Impacts

The research showed that B2B entrepreneurs highly value online channels, because it strengthens their competitiveness, especially in exports.

Nevertheless, there is some nuance with three of the participants recognising the value provided by online channels and how they add value in a gradual way:

"There is a gradual value of online channels. There is the B2B that sells wine in restaurants, the B2B that exports wines in San Francisco and the B2B that handles Athens wholesale. Hence the B2Bs have important stratification.

The Athens wholesaler who's responsible for the distribution, values highly its online profile. The restaurant, bar etc. distribution benefits greatly from the online channels, which in turn are incredibly important for the exports". (R5)

The research highlighted that competitiveness increases the challenges faced by B2Bs. Innovative ideas that formulate digital strategies, are often employed to meet those challenges.

Two business managers consider the final product volatility and its transportation cost, that often exceeds the product itself, as major drawbacks:

"The challenges are significant. Our primary concern is competitiveness, where especially in the jewellery business there are many providers. Therefore, there is an ever increasing need for innovative ideas, that evolve digital technology strategie"». (R3)

The impact of digital sales showed significant importance, thus the participants feel obliged to constantly upgrade their products. Meanwhile, Greece exhibited a significant digital deficit, in comparison to other European countries:

"You must read the market trends in time to adjust your product accordingly. Being aware of how and in what direction your business strategies must be directed, is of great importance. The greatest challenge is addressing Greece's digital deficit, when compared to other countries in Europe". (R8)

As far as B2B competitiveness is concerned, the participants express the need for major green and digital adaptations:

"Adapting to a greener and more digitally friendly environment is eminent. This involves training staff with specialised digital skills and monitoring the competitive landscape and current market trends". (R9)

Training on novel digital tools and creating a more sustainable greener working environment, was mentioned as a way to increase business competitiveness and a way of opening B2B market, especially when these efforts aligned with the country's digitization, creating the need to align business with central strategies.

4.2 Choice Making and Strategy Formation

The research showed that B2B companies choose their digital strategies according to business characteristics, their products and their buyer's profiles:

"Digital strategies are developed according to the innovations we have developed and the biomass management, as well as how environmentally friendly and compliant with EU policies, those strategies are". (R12)

The participant entrepreneurs find market research and competitor analysis, right targeting, appropriate partnership, innovative ideas and digitally specialised human resources, as major determinants for their digital strategies formation:

"Creating a successful digital marketing plan needs thorough research of the market, the competitors and your target audience as well as sufficient funds for those implementations". (R6)

For the evaluation of digital marketing plans, B2B companies can utilize tools like Google Analytics, social networking platforms such as Facebook Insights, Twitter Analytics and LinkedIn Analytics, along with advertising platforms like Google and Facebook Ads:

"Some of the main tools employed involve Google Analytics, that provides us with detailed information about our website performance. Also, social media platforms like Facebook Insights, Twitter Analytics and LinkedIn Analytics, provide metrics on Ad performance, audience interaction and community growth. Finally, advertising platforms like Google and Facebook Ads helps us create, manage and evaluate our advertising campaigns". (R7)

B2B entrepreneurs are developing their digital marketing strategies by exploring markets and current trends, as well as by building trusting relationships with their customers:

"*We definitely analyse trends in B2B to understand the market". (R9)*

We create customized offers and design content that addresses current needs. We constantly upgrade and adapt our digital environment according to customer needs». (R1)

Furthermore, the participants reported that they constantly comply with the data management and data protection regulations:

"We dutifully comply with the Greek legislation and the EU Data Protection Regulations". (R12)

Constant upgrade and environmental adaptation, with great consideration on being safe and creating an environment that highly respects and protects personal data, were highlighted as major pros, that can create a healthy digital business strategy.

4.3 Mutual Interests and Partnership Support

The research demonstrated that digital transactions have a positive impact on B2B partnerships by creating a mutual trust relationship, *due to their speed and freed from bureaucratic subjectivities:*

"Digital transactions highly impact B2B partnerships. Digital transactions, especially financial ones are exceptionally fast and no longer subjected to bureaucracies. These factors significantly facilitate mutual trust building amongst partners". (R14)

There was a general consensus amongst participants that digitalisation, creates a competitive advantage, brings businesses together in a transparent way and creates value upon which mutual trust and partnership satisfaction are built:

"The B2B digital sales environment is complex, but digitalisation creates the competitive advantage that brings our customers closer to us. At the same time, an appropriate and transparent connection with our customers creates the value of trust and partnership satisfaction". (R11)

Furthermore, the customer feedback loop in B2B businesses, dynamically improves product development, digital networks and digital strategies:

"All the customer information obtained are carefully evaluated. This information creates an indirect link to the end customer, creating the necessary conditions to improve our end products and our digital marketing plans". (R8)

B2B business customers perceive the reciprocity of interests between the two parties which augments customer satisfaction. Creating a customer connection improves digital marketing plans and strengthens competitiveness:

"We try to get feedback from our customers and analyse it, with the aim to improve our digital strategies. This creates a satisfactory environment for our customers, who feel the reciprocity in our transactions consequently creating continuous product and services improvement, that creates a competitive advantage". (R4)

Digitising transactions was thought to create trustworthy partnerships, that can be constantly evaluated and improved, creating a link between the B2B, its product, the customer and their satisfaction about the whole experience. The time saved and the direct link between the interested parties reinforces connection and strengthens competitiveness.

5. Discussion

The research showed that B2B entrepreneurs place significant importance on online channels, as they believe these improve their competitive position and help them address challenges. They consider adaptation to green and digital environments as essential, and at the same time, they acknowledge a digital deficit compared to similar businesses in other European countries. They utilize digital strategies based on innovative ideas in order to address challenges. These businesses consider price volatility and carriage charges, which often exceed the cost of the product, as key barriers to their sales.

By comparing these findings with the literature , we confirm that digitalisation creates opportunities and challenges for businesses (Paunović et al., 2024; Ritter & Pedersen, 2020). Simultaneously, the digitalization may contribute to the establishment and configuration of comprehensive and targeted communication on which relationships of trust, mutual interests, and mutual support are created (Royle & Laing, 2014; Wymbs, 2011). Additionally, the literature suggests that digitalisation is the key to increasing efficiency and revenue (Rodríguez et al., 2020; Román & Rodríguez, 2015; Tanner & Shipp, 2005) and it constitutes a source of competitive advantage in the complex sales environment (Leeflang et al., 2014; Andzulis et al., 2012; Gil-Saura et al., 2009). The digital gap and digital lag in Greece are highlighted in numerous studies (Laitsou et al., 2020; Kontolaimou & Skintzi, 2018). Andzulis et al. (2012) assert that social networking is important at every step of the B2B sales process. However, the research by Ahearne & Rapp (2010) showed that digitalisation rarely replaces human interaction. The same result was shown by the study of Moen et al. (2008), which emphasized that face-to-face

interaction is the relationship that solidifies sales. It should be noted that no such findings were observed in the current research.

The study revealed that B2B companies choose their digital strategies based on the characteristics of the business, their products and the specific characteristics of the businesses that purchase their products. They emphasize understanding the market and prevailing trends, as well as establishing trust-based relationships with their customers. They consider through market and competitor research, precise targeting, suitable partners, innovative ideas, and specialized human resources in the digital environment to be decisive factors for the success of their digital strategies. In their digital campaigns, they utilize Google Analytics, social media platforms such as Facebook Insights, Twitter Analytics, and LinkedIn Analytics, as well as advertising platforms like Google Ads and Facebook Ads.

Finally, they place importance on data management and data protection. Comparing these findings with the international literature, we find compatibility. Data must be used in accordance with local and international legislation (Tankard, 2016). Dasser's research (2019) indicated that digitalisation is the triggering event that transforms B2B. Similarly, Bakhtieva et al. (2017) found that strategic digital marketing creates value for the business and enhances customer loyalty. Andersen et al.'s (2017) research showed that digital campaigns with their content, transform B2B, easily penetrate the market and increase sales.

The research has shown that digital transactions have a positive impact on B2B collaboration by fostering mutual trust, as they are fast and less subject to subjectivity and bureaucracy. Digitalisation creates a competitive advantage, brings businesses together and creates value on which mutual relationships of trust and satisfaction are formed. Of course, personal, face-to-face interaction is important, but the study has confirmed that in the absence of in-person digitalization can pave the way for mutually beneficial business relationships into the B2B setting.

More specifically, the exchange of information in B2B businesses with customers is considered a creative force that improves production, digital networks and digital strategies. In B2B transactions, customers recognize the reciprocity of interests, which leads to satisfaction. Through this reciprocity of interests, many digital strategies are improved and the competitive advantage is strengthened. These findings are congruent with the results from other studies. According to Gil-Saura et al.'s research (2009), the value of relationships is a factor that shapes trust and satisfaction in the digital environment of B2B businesses. The bilateral nature of digital transactions, also, shapes the balance of mutual interests (Bryan, 2018; Royle & Laing, 2014). Digitalisation has led to a revolutionary change in sales (Marshall et al., 2012) and has built robust relationships of trust and mutual interests (Royle & Laing, 2014; Wymbs, 2011). It facilitates interactions between businesses and employees, customers, and competitors (Apostolopoulos et al., 2022b). Also, it enhances the organizational and individual performance of employees, which contributes to maintaining good relationships with customers based on mutual interests (Cartwright et al., 2021). However, the issue is a complex one, where some studies suggest diametrically opposite findings, such as the research by Arli et al. (2018), which showed where it was found that digitalisation often undermines the creation of trust-based relationships.

6. Conclusion

The degree of digital transition varies from country to country and business to business, with the phenomenon of the digital divide being a reality that can only be mitigated through specific policies. On the basis of a gap in knowledge surrounding the application of digitalization in the B2B domain, especially within a Greek context, this study has provided some first insights upon which others may build. The study confirms that digitalisation, by transforming the traditional method of sales, creates new dynamics in B2B sales, reshaping sales strategies on a new base. It can support the creation of a competitive advantage and fosters mutual relationships of trust and satisfaction with honesty and objectivity to traders. Concerns surrounding the ability of digitalization to lead to trusting business relationships compared to more traditional in-person forms of relationship-building were not confirmed. Indeed, participants noted that a sense of reciprocity in digital relations led to an increase in transactions, the improvement of digital strategies with implications for strengthening a firm's competitive advantage.

Furhter benefits of digitalization in the B2B domain were acknowleged: The dynamics of digitalisation in B2B sales create new balances of mutual interests and supportive collaborations with customers. It enhances the organizational and individual performance of employees, which aids in maintaining good relationships with clients based on mutual interests. The reciprocal exchange of data and information in B2B is considered a creative force that improves product outputs, digital networks, and digital strategies.

A limitation of this study is the sample's restriction to entrepreneurs and executives in B2B, and here with a specific focus on sales. A similar study involving employees in B2B sales, as well as entrepreneurs who procure products or services from B2B sources, would provide a more comprehensive perspective.

As digitalization continues apace, this study's findings should prove valuable to those seeking to develop an international understanding of the digitalization phenomenon. The story here is that within a Greek context in the B2B domain digitalization was largely seen very positively. It strengthened existing business relationships, and, crucially for those seeking to develop entrepreneurship (e.g. policy makers), it fostered the creation of new relationships and new businesses.

Ethics Declaration

We hereby declare that no ethical clearance is required for the research / not applicable

AI Declaration

We hereby declare that no AI usage has been carried out throughout the conduction of the study and the preparation of the relevant manuscript.

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A Case Study of Experiential Entrepreneurial Learning Through LEGO® Play

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Abstract: Classroom learning through LEGO® play, or LEGO Serious Play™ methodology has been implemented within educational curricula for many years (Ng Yong Liang et al., 2021). The prominence of this approach in Higher Education management education (Martin-Cruz et al., 2022; McCusker, 2020) is growing, where LEGO® building has been viewed as a tool to help unpack management issues using creative play strategies (McGehee, 2022). Entrepreneurial learning differs from traditional, didactic learning by instead pedestalling experiential activities through learning by doing (Macht & Ball, 2016) and subsequent reflections (Kolb, 1984), essentially mimicking how entrepreneurs learn in practice (Ries, 2011). This case study focuses on providing entrepreneurship-focused learning for Foundation (Level 3) Business and Management students at a UK-based HE University. The case demonstrates a unique curriculum approach that delivers students a learning-by-doing experience through LEGO® play, before subsequently facilitating the reflective mapping of learnings to fundamental entrepreneurial concepts and skills. The class activity begins with students placed in teams, and being challenged with a seemingly simple LEGO® play task of building a model car which will subsequently be tested against other teams' models. However, the task has been strategically devised to include purposeful complications (e.g. LEGO® sets deliberately tampered with where key pieces or instruction books/pages are missing) meaning the initially straightforward task required students to use creative problem-solving entrepreneurial skills to successfully complete. After the models were tested and a team provisionally crowned the 'winner', the real learning comes from the second part of the session challenging students to assess their experiential learning from the activity through a deep reflective review, constituting a fundamental component of the learning process. Data was captured through both researcher observations during the activity and learner-centric data from student presentations of their identified learning. Initial analysis of the findings identified that students mapped a spectrum of entrepreneurial concepts and skills developed from the activity (including risk-taking, adaptability, teamwork, creativity, innovation, resourcing, and leadership), illustrating how integrating LEGO® play with experiential learning approaches can foster an effective and engaging student-led learning experiences in the classroom.

Keywords: Experiential Learning, LEGO, Creativity, Innovative, Design Thinking

1. Introduction

As LEGO® play becomes increasingly utilised for classroom interventions and novel learning experiences, increased academic and professional consideration is being sought to substantiate the approach. This case explores an integrated design-thinking perspective to developing an experiential learning session delivered through LEGO® play. Where LEGO Serious Play™ can be prescriptive and restricted to delivering just the activity itself, this case study was designed and facilitated with reflection built in, giving an arguably more authentic and useful learning experience for students. This session was trialled with Level 3 Business and Management students within an Entrepreneurship and Innovation module, seeking to explore a) How do LEGO®-based activities impact students' experiential learning?, and b) How does structured reflection after LEGO® activities enhance this (entrepreneurial) learning? To answer these questions, both student and facilitator perspectives have been explored, showcasing an evolving session design which could potentially be implemented across a broad range of subject areas for similar effective results. This paper illustrates how students responded with creativity when faced with issues of ambiguity. Students were able to identify an incredible 68 different entrepreneurial concepts and skills from completing this activity.

This paper brings a purposive, design-thinking approach to experiential learning inside the classroom. Through developing a LEGO® play intervention with built in reflection, the approach adds academic application to LEGO® based sessions, progresses conversations of authentic and experiential learning (Curtis et al., 2021) and addresses concerns regarding the challenge of students' reflection (Yeoh, 2017).

2. The Setting

This case focuses an Entrepreneurship & Innovation (E&I) module provided to Foundation level (level 3) Business Management students at a UK-based HE University. Foundation programmes provide an alternative pathway for students not achieving the requirements for direct entry to full undergraduate degrees. Students study six

business-related modules over a year, to subsequently gain access to their preferred full degree programme. Typically, the foundation programme has 120-180 students enrolled each year.

The E&I module was designed and implemented from 2020/21, initially for synchronous online delivery due to COVID-19 restrictions, before fully in-person synchronous from 2021/22 onwards. It is delivered over the period of a semester (12 weeks), aiming to provide students with entrepreneurship and innovation insight and learning, regardless of their subsequent chosen business degree path. Weekly, students receive a whole-cohort 1-2-hour lecture, with smaller group (30-40) 2-hour seminars (facilitated by two staff members). Assessment is 100% group-based, with teams of 6-7 members, where students can partly self-select their team composition during week 3.

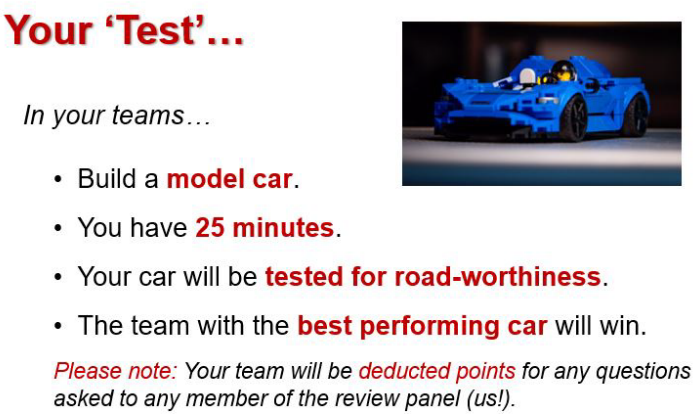


Figure 1: Model Building Activity

This case focuses on one specific 2-hour seminar activity. It was originally developed to help increase teamworking, communication, problem solving skills through LEGO® play. The activity requires students to construct a simple LEGO® model car using a LEGO® Creator 3-in-1 box within a defined time limit (see Figure 1). However, the task has been strategically devised to include purposeful complications, for example key pieces are missing, instruction books or pages are removed, and how the models are tested and the time remaining is deliberately withheld. Students therefore need to cope with ambiguity, adapt creatively to quickly solve problems, or even take some risks to succeed. Each model car is competitively tested in the classroom (propelling it from one side of the room to the other, with distance and intact-ness as marking criteria) and a winning team announced. Student feedback was positive and encouraging, for example, one student stated choosing the Entrepreneurship Degree as a direct result of this session. On review of the module, the teaching team wanted to improve upon this activity further, focusing not only on teamworking, but additionally magnifying the multiple entrepreneurial skills potentially espoused through completing this activity – thinking; What if we could ask students to map this experiential LEGO® play activity to entrepreneurial skills and concepts?



Figure 2: Additional Reflective Task

The initial activity task was identical to previously, however, an enhanced additional task was then added after the road-test challenging students to evaluate their performance and experience through a deeper reflective

review (see Figure 2). Students were encouraged to find entrepreneurial skills and concepts (through any means necessary – usually search engines on mobile-phones and laptops) and to actively map these against their experience of the activity task. Teams articulated their learning through presenting mind-maps on flip-chart sheets with considerable and highly positive results. Teaching staff subsequently re-award a winning team based on the teams' identification of concepts and associated reflections and learning, rather than the model-building activity, where ultimately the winners are those who learned the most from the experience and related it to the topic.

3. Literature Review

This case study addresses emerging threads within entrepreneurship/enterprise education and wider higher education requirements for authentic learning experiences. An overview of the literature through design thinking, experiential learning, and reflective learning highlights pertinent opportunities to further discuss our findings.

3.1 Literature Topic 1 - Design Thinking

As 'a way of thinking', design thinking is regarded as a cognitive process followed by designers while working on projects (Liedtka, 2020; Val et al., 2017). The principle of design thinking is human centred. The process starts with good understanding of people and their needs, the designers design the process, aiming to meet their needs. Design thinking is recognised as an innovative approach to encourage people to engage the process and dive into the human-related problems. It allows designers to explore many possible solutions in the first place to the problem, then develop users' ability to offer unique and diverse solutions (Brown, 2008; Carella et al., 2023; Garbuio et al., 2018).

Design thinking as a method of creative action (Brown, 2019) and an 'open' problem solving process (Rittel & Webber, 1973), Scholars have defined its processes in different ways. Brown (2019) and Liedtka (2015) developed five key stages for design thinking: ***empathize*** (understanding user needs); ***define*** (identifying the problem); ***ideate*** (brainstorming multiple creative solutions); ***prototype*** (creating tangible representations of ideas) and finally ***test*** (refining solutions). This five-stage process reflects the 'learning-by-doing' and 'trial-and-error' characteristics by blending critical thinking and experiential learning, which are essential to entrepreneurship education (Baltador et al., 2024; Liedtka, 2015).

Design thinking and project-based learning mode has emerged as an innovative education approach applied to different research areas, particularly in problem-solving and creativity (Baltador et al., 2024). Entrepreneurs face different dynamics and overall elevated complexity on the daily basis (Val et al., 2017). Being a successful entrepreneur requires skills like risk-taking, identification of new opportunities, adaptability and innovative competences (Carella et al., 2023). Design thinking could foster these entrepreneurial key trails. García et al. (2017) emphases that the application of design thinking in curriculum design could help students in shaping their entrepreneurial mindset by dealing with wicked problems and identify hidden issues.

3.2 Literature Topic 2 - Experiential Learning

There is a plethora of empirical literature within the field of entrepreneurship education which argues that an authentic experiential approach to learning is better than traditional knowledge-sharing methods for improving deeper learning (Cope & Watts, 2000; Curtis et al., 2021; Jones et al., 2019). Mimicking how entrepreneurs themselves learn (Ries, 2011), strategies to create 'learning by doing' experiences by which students can immerse themselves into authentic or simulated activities has also been well documented (Kolb, 1984; Macht & Ball, 2016). Experiential learning is not just captured within entrepreneurship education as a meta-analysis of 89 empirical studies comparing experiential versus traditional methods concluded that "students experienced superior learning outcomes when experiential pedagogies were employed" (Burch et al., 2019, p. 239). However, previous literature demonstrate links between experiential learning and entrepreneurship education are intrinsically aligned (Jones et al., 2019; Vij & Ball, 2010). Entrepreneurship education is increasingly being viewed as important for all students, regardless of discipline. Even if students are not planning on starting a business in the near future, entrepreneurial behaviour can support the learner's employability (Bell, 2021).

LEGO® building has been viewed as a tool to help unpack management issues using creative play strategies (McGehee, 2022). McCusker (2020) discusses how LEGO Serious Play™ can open up new classroom interactions through valued team participation. It provides an experimental approach which helps to enable intuitive

instruction, communication, participation, and collaborative learning in order to solve a perceived problem (Martin-Cruz et al., 2022). Engaging students with LEGO® Serious Play group challenges within a classroom environment encourages collaboration and communication, developing group cohesion and unity (Peabody & Noyes, 2017). It is an innovative way to promote social and cognitive skills that will be essential for students of new generations (Pedregosa-Fauste et al., 2024). LEGO® play has not only been used as a tool to facilitate classroom learning, but also to facilitate classroom thinking too (Ng Yong Liang et al., 2021).

3.3 Literature Topic 3 – Structured Reflection / Reflective Learning

Due to the likely uncertainty and ambiguity which abound entrepreneurial careers (Fisher et al., 2020; McMullen & Shepherd, 2006), the importance of reflection and subsequent learning is increasingly pedestalled within the discipline (Hägg, 2021; Kurczewska et al., 2018; Tan et al., 2024). Such a reflective period often is required following business failure or significant work-based challenges (Bae et al., 2025), enabling individuals to undertake the necessary sensemaking (Weick et al., 2005) to understand and overcome their situation (Maitlis & Christianson, 2014; Sandberg & Tsoukas, 2020). Such high-stakes settings are challenging to recreate in the classroom, however reflective learning could provide a bridge between theory and practice (Hägg, 2021), significantly aiding competence understanding and development specifically when scaffolding by the facilitating academic(s) and lesson-plans to support students through the process (Tan et al., 2024).

Emerging work is starting to explore reflective learning for entrepreneurship students. Tan et al. (2024) identify the integration of reflective learning (utilising Kolb (1984) and Gibbs (1988) frameworks) to experiential learning "significantly enhances the breadth and depth of entrepreneurial competencies" (p. 387) compared to a module control group, results which affirm recent calls through pedagogical research for more innovations and student reflections in business schools (Harney et al., 2021). Such reflective practice may not just impact the immediate learning of entrepreneurship students, arguably equally impacting personality constructs over time (including conation, cognition, and affection) (Kurczewska et al., 2018).

Reflective learning may be particularly crucial when traversing paradigms of thinking required to move from one context to another (Prashantham & Floyd, 2019). Such contexts are often afforded through aforementioned experiential learning pedestalled in entrepreneurship education (Burch et al., 2019; Curtis et al., 2021), specifically as students may need to unlearn or challenge existing beliefs predicated from previous educational settings (Klein, 2008; VandeSteeg, 2012). This said, sensemaking (Weick et al., 2005) and reader-response (French, 1987) ideologies essentially posit empowering individuals themselves to construct their own understanding, resultantly such approaches should not be limited to *just* entrepreneurship education settings, as understanding could be generated *in* and *for* any setting or discipline. The required reflective learning through independent, written form can be initially challenging for students, who find the difficulty with the self-confessional writing approach (Yeoh, 2017) where instead utilising a collective, facilitated sensegiving and sensemaking exercise could overcome some of these barriers to learning (Abrahams & Singh, 2010; Lans et al., 2013).

Reflective learning plays a considerable role in constructing meaning around experiences and events. This seems specifically apparent in entrepreneurial settings, where uncertainty and ambiguity emanate. Despite the usefulness, challenges regarding the *act* of reflection can be barriers for students traversing both new educational settings and paradigms of thinking, meaning active classroom facilitation, almost reflection without realising, could be imperative.

Utilising a design thinking education approach and espousing experiential learning and reflection throughout, this case demonstrates how an innovative LEGO® Play task can be utilised to develop and facilitate entrepreneurial skills.

4. Methodology

This research aims to investigate how LEGO®-based activities enhance students' creativity behaviours in the classroom. To gain 'insights' and 'rich information' (Richards, 2020), we collect primary data from multiple levels, including participant observation and students' written posts. The combination of these empirical research methods from qualitative stance helps us focus on understanding of students' creative behaviours during the LEGO®-building process.

Observation method has been widely used in pedagogy studies, especially in studying creativity in education (Katz-Buonincontro & Anderson, 2020). Observation enables researchers to 'visit little-known tribes and record

their activities for subsequent analysis and interpretation' (Cotton et al., 2010, p. 463). There are different types of observation methods based on the observation roles, including complete participant; participant-observer; observer-participant and complete observer (Merriam & Tisdell, 2015). We adapt participant-observer, in which the researcher engages in the same activities alongside research participants in the study without cancelling our identities. Three researchers conducted 7 observations, which generated 24 observational units (individual groups). The observation template is designed before actual observation were conducted, including five categories and seventeen sub-themes. Extensive details about students' activities and performance are recorded in the observation templates using notations and taking photographs. in addition to the observations, we also collected written posters drawing by students in the classroom. The combination of collected visuals and text in the posts provides rich information allowing us to analyse students' learning experiences through reflective learning.

Given the nature of the qualitative research of this study, our data analysis approaches combined thematic analysis (Boyatzis, 1998) with content analysis (Bernard et al., 2016). Thematic analysis method is used to identify, analyse and interpret patterns and themes emerged from our observation data. For students' posters, both quantitative and qualitative content analysis were employed. First, we quantified the presence of certain words for all collected posters. As the last stage of data analysis, we attempt to connect emerged key words and patterns to our research questions.

5. Findings and Discussion

Observational and reflective data was collected from 22 small groups of students.

5.1 Linking Design Thinking with LEGO® Curriculum Design /Design Thinking in the Context of LEGO®- Building Activities

Building upon our initial interactions with students, the historical participated observation and students reflection experiences, the teaching teams (the designers) interacted the 5 stages of design thinking to influence students' entrepreneurial skills development through LEGO® curriculum design (see Table 1).

Table 1: Design thinking and LEGO® activities in curriculum design

DT Stages	Goals	Implementation in LEGO® Activity Design
Empathize	Understanding user needs	*The designers (tutors) tried to have the best understanding of students' needs – developing Ent. Skills/prepared themselves with competence skills to address real-world problems.*
Define	Identifying the problem	*What Ent. skills students lack of and need to be developed through LEGO®-building activities (i.e. risk taking, problem-solving as the **competence** skills for entrepreneurs)*
Ideate	Brainstorming multiple creative solutions	*Design LEGO® activities by considering multiple ways which LEGO® can be used to address the identified needs in the define stage*
Prototype	Creating tangible representations of ideas	*The design team developed LEGO® challenges for students, encouraging them to produce their products by doing, trying and failing.*
Test	Refining solutions	*Conducted the LEGO® activities in the classroom and asked students to reflect on what they learned and how they felt.*

Implementing the 5-stage design thinking process in LEGO® curriculum design, the teaching team created a highly engaging, student-centred and iterative approach to entrepreneurial skills learning. The following demonstrates how the teaching team applied each stage effectively:

1. Exploring and gathering insights of students' interests, motivations and learning difficulties (classroom observations and students' LEGO® play behaviours) - **Empathise**
2. Defined specific learning objectives where LEGO® is integrated: dealing with uncertainty, risk-taking, problem-solving etc. – **Define**
3. The teaching team deliberately took out some LEGO® pieces and the instruction book without informing to students in different LEGO® boxes to observe students' reactions and actions during the LEGO® paly process – **Ideate**
4. Build the LEGO® car during the class and ask students present a road test at the end – **Prototype**
5. Conduct the pilot session in the classroom, and collected feedback from students and other colleagues to refine the LEGO® curriculum model – **Test**

The design team looped back to these 5 stages in the design thinking process based on the observations of students' reactions and reflections in the LEGO® play activities.

One of the three research objectives was to investigate how to integrate Design thinking in LEGO® based activities in entrepreneurial education from both tutors and students' perspective. Our evidence captures two key principles when designing LEGO® based activities to develop students' entrepreneurial skills and competencies. Firstly, design thinking can be used as a non-linear loop to capture students' learning needs and help staff, as designers, adjust LEGO® learning activities to foster students' entrepreneurial competence (Baltador et al., 2024). Secondly, integrating design thinking into the LEGO® curriculum design, embedding the 5 design thinking stages (Brown, 2008) cannot be isolated from the LEGO® play activities (experimenting) and post reflections (trial-to-error).

5.2 Observations

Staff observations from the activity showed that most teams opened the box prepared to follow instructional guides to build their model as quickly as possible adhering strictly to instructional guides (when available). Teams would delegate team roles to tasks such as sorting parts by colour, or identifying the correct parts by page and then passing onto other team members to assemble.

However, as stated previously, LEGO® box parts and/or instructions had been manipulated, so that some teams had key parts missing, or key instructions missing, or no instructions at all (coping with uncertainty / ambiguity). Teams with the no instructions either decided to just get on with assembling a new model (creativity / innovation) or, negotiated with competing teams for access to a 'spare' instruction book (negotiation) or, used mobile phones to search for the LEGO® Creator instructions online (resourceful). Some teams hid their model designs from other teams (protecting IP), and some teams observed other model builds (collaboration). Some teams even stole missing parts from other teams in the session (ethics)! One team decided not to use LEGO® at all, but instead, built a makeshift car from classroom furniture (thinking outside of the box). Many teams discussed asking tutors for advice, but realised asking questions would lead to a penalty (risk-taking). Not surprisingly, (nearly) all teams did not monitor time constraints, and therefore, several models were not test-ready, with some missing keys parts such as wheels. However, some cohesive teams did complete well within the defined duration, and made time to test during assembly, and on completion of their model car.

5.3 Data Analysis From the Reflections

22 learner flip-chart reflections were analysed and correlated by identifying every keyword used within the mind-maps to illustrate what students had identified as the essential entrepreneurial skills and concepts from the activity. Learner groups identified between 8 and 20 keywords per team, with a total 86 individual keywords identified. The frequency was also analysed to identifying the most used keywords (see figure 4).

That frequently data showed that the 2 main keywords occurred were innovation and risk taking (22%). Teamwork, creativity, adaptability, delegation, problem solving, and time management occurred between 10-20%, and then coping with ambiguity, thinking outside the box, vision, model testing, opportunity recognition, and perseverance occurred between 5-10%.



Figure 3: Frequency of keywords identified

6. Conclusions and Recommendations

This case study set out to illustrate how using LEGO® play in the classroom can be a very powerful tool for students to use experiential learning to seek and identify key skills and concepts used in entrepreneurship education. LEGO® play empowers students to be more interactive in the classroom. This experiential learning activity has identified 86 keywords from just one 2-hr seminars (from 22 teams). Observations showed that students were adaptive to creative problem solving under conditions of uncertainty and ambiguity, testing out rule restrictions in a very entrepreneurial style. It shows that experiential group-learning can have positive outcomes for students, whilst also having some creative fun in the classroom too.

Adding the final reflective question at the end of this activity engaged students in a much more dynamic way, breaking down traditional barriers to learning whereby knowledge is often only transmitted to them. Students were able to map and qualify their learning in a way that traditional methods fail to do. LEGO® play activities such as this can easily be adapted for many other disciplines too. Skills such as teambuilding, problem solving, creativity, innovation are not exclusive to entrepreneurship education but are very transferrable skills that most employers are seeking from Higher Education graduates.

Ethics and AI Declaration

Ethics approval has been submitted and approved by Northumbria University (Ref: 10000). AI tools have not been utilised in the production of this paper.

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Selling the Problem, not Just the Technology

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Abstract: Artificial Intelligence (AI) continues to attract significant interest from businesses eager to integrate it into their operations. However, misconceptions about AI's capabilities—often inflated beyond what data quality and context allow—can hinder successful adoption. Clients may not fully grasp the value of AI tools, which leads to poor implementation choices and inaccurate outcomes. This research addresses the question: *How can the added value of an AI tool be effectively communicated to clients?* Rather than highlighting technological potential, the study shifts focus toward understanding client needs. A survey among companies, combined with academic insights, informed the development of a more nuanced sales approach. The findings reveal that sales strategies must be adapted depending on the client's level of AI maturity. For those with defined AI goals, engaging high-level decision-makers helps clarify challenges and tailor solutions. For clients without specific AI plans, the emphasis should be on uncovering key business problems through guided dialogue before introducing AI as a solution. The study underscores the importance of "selling the problem" rather than merely promoting the technology. Effective communication strategies include using real-world examples, visual demonstrations, narratives that illustrate transitions from current to desired states, and discussions of potential risks to support informed decisions. Notably, Proof of Concepts (POCs) are not seen as effective primary tools for showcasing value. In conclusion, aligning AI sales strategies with client perspectives enhances trust and clarity. By emphasizing problem-solving and leveraging social proof, companies can better communicate the true value of AI tools and increase the chances of successful adoption.

Keywords: AI Adoption, Sales Strategy, Client Communication, Value Proposition

1. Introduction

Artificial Intelligence (AI) is gaining increasing attention, and organisations are eager to integrate this technology into their operations. However, the power of AI is often overestimated because its effectiveness depends on the quality of the data on which it is trained.

Within this context, a dynamic develops between AI providers and their (potential) clients. While providers create advanced tools, they often find that convincing clients is complex. In their view, clients frequently lack a sufficient understanding of certain aspects of AI, leading to misunderstandings about what a specific tool can and cannot solve.

Selling an AI tool can be particularly challenging, especially when it comes to clearly demonstrating its added value from the outset. When potential clients fail to grasp this value, they may resort to an alternative AI tool that is ill-suited to the problem they are trying to solve. This increases the risk of receiving inaccurate outputs, which can lead to significant consequences.

This research is conducted to better understand how to approach and comprehend clients, enabling AI providers to tailor their sales processes accordingly.

That clients struggle to understand what is required for the implementation of AI is evident from a study conducted by the Boston Consulting Group and MIT Sloan Management Review (Stackpole, 2022). The research indicates that of the surveyed leaders considering AI adoption, only around 16% are recognised as Responsible AI (RAI) leaders. These RAI leaders achieve superior results because they view AI as an organisational challenge and prioritise developing comprehensive RAI programs. The study identifies that a significant reason many leaders struggle is their tendency to see AI primarily as a technical challenge, rather than addressing it as a (strategic) organisational issue. RAI leaders report feeling better prepared to manage AI-related risks and engage top management effectively, which are crucial factors for successful implementation.

The BCG study also suggests that many leaders may not fully understand the extent of AI's added value. This is likely because they often view an AI solution as a straightforward technical implementation, whereas in reality, AI can have a much broader, strategic impact on the organisation. This study aims to provide better insights into ways to enhance the interaction between AI providers and customers to improve the value AI can deliver to organisations.

1.1 Urgency and Relevance

For clients looking to leverage the benefits of AI, this research may provide a significant contribution. An optimised sales process from AI tool providers can help mitigate the associated risks. In light of the current "AI hype," this research is also relevant (Expert, 2024). All this leads to the central research question:

"How can the added value of an AI tool be effectively communicated to clients?"

To address this question and offer a well-supported conclusion, the following structure is used in this document:

- Methodology: This section outlines the approach used to answer the research question.
- Findings and Discussion: This section presents the research findings and compares them with insights from existing literature.
- Conclusion and Recommendations: This section draws conclusions based on the findings and provides practical recommendations for businesses.

2. Methodology

To clearly analyse the problem and generate actionable insights, this research was conducted using a combination of qualitative and quantitative research methods. The approach consists of two phases: developing a perspective (view of reality) and conducting a customer analysis to further investigate the pain points. Below, the approach to each phase is explained.

2.1 Development of the Perspective

The perspective was developed by combining various sources of information. Desk research and a literature review involved the use of scientific articles, theories from business administration and marketing, and other reliable resources to gain a comprehensive understanding of the topic. Practical insights were gathered by consulting the internal database of an AI company called Consono, a data management firm that offers a unique platform called Dynizer. Additionally, interviews with professionals in the field were conducted to gather insights into their views on AI and client approach.

From these sources, it becomes clear that the following factors must be considered when selling AI:

- Level of prior knowledge: How much does a client company know about AI?
- Level of commitment: Is the company truly dedicated to working with AI, or is it a necessity based on following the AI hype?
- Context and stakeholders: Which roles within the company are involved in implementing an AI project?
- Organisational development stage: For understanding the change process the client organisation goes through, we analysed a which stage of change the client is, using the Adaptive Cycle of Resilience approach (Abcouwer et al., 2020; Takács & Abcouwer, 2020)
- How an AI technology provider sells an AI tool.

2.2 Customer Research: How and Why?

To better understand the four factors from this perspective, a customer analysis was conducted. Questions were formulated in line with the perspective. A combination of surveys and interviews was chosen for this analysis.

The survey was developed in collaboration with our research partners, Consono and Oracle (a leading technology company specialising in database management, cloud solutions, and enterprise software). The initial interview guide was reviewed by professionals from both organisations and subsequently pre-tested with two individuals from the target audience (healthcare and public sector). These pretests involved conducting full interviews to assess whether the questions effectively captured the intended information and to identify any missing elements. Based on the feedback, several questions were refined. The second interview confirmed the adequacy of the revised guide and was included in the final analysis.

Drawing from the validated interview guide, the survey was designed with mostly multiple-choice questions to maximise response rates and allow for comparability. The surveys were then distributed through business events, email campaigns, and LinkedIn posts, targeting organisations across various sectors. It was not essential

which specific employee within a company completed the survey, as responses from different roles offered diverse and valuable perspectives.

To support and validate the survey results, semi-structured interviews were also conducted with a small group of potential clients during a live event. These interviews provided deeper insights into client needs and perceptions around AI adoption and served both to triangulate the survey findings and enrich them with qualitative data. The interview protocol allowed for structured questioning with the flexibility to explore specific themes in greater depth, depending on the respondent's role and context.

The survey garnered a total of 21 responses. This suggest that the results cannot be considered a formal market study. Distributing our questionnaires to contacts and clients of Consono and Oracle may have introduced biases within our research population. Acknowledging these limitations, the findings were compared with insights from scientific literature, upon which conclusions are subsequently based.

The survey was designed so that, depending on the respondent's answer to a certain question, different follow-up questions could appear. As a result, some questions were not answered by all 21 respondents.

2.3 Scope

This issue focuses on optimising the sales process for AI providers, targeting industries where data exchange takes place and large volumes of data are processed. This segment has been selected because the problem predominantly arises within these industries.

Most respondents come from the following sectors:

- IT/Technology
- Healthcare
- Government
- Consultancy
- Education

3. Findings and Discussion

In this section of the paper, we will address the factors that emerged from the perspective described above. In each paragraph, the survey questions related to the respective factor will be discussed.

The analysis will answer the following questions:

- Why was this question asked of the respondent?
- What are the results?
- What conclusions can we draw from this?
- Does this align with scientific research?

Some survey questions will not yield relevant connections and will therefore not be discussed in this chapter.

This all leads to the following analysis:

3.1 Level of Prior Knowledge

3.1.1 Organisational or Technical Issue

As previously mentioned, a study by Boston Consulting Group and MIT Sloan Management Review (Stackpole, 2022) reveals that among the surveyed leaders looking to adopt AI, approximately 16% are identified as Responsible AI (RAI) leaders. According to the BCG researchers, a key reason for the challenges many leaders face is their tendency to view AI as a technical issue, whereas, in reality, it are the organisational factors that must be addressed at a strategic level.

To explore this, the following question was posed to all managers/leaders:

Do you consider your plans for AI more of an organisational or a technical issue?

- Organisational refers to the adaptation of acceptance, support, and the renewal of work processes within the company.

- Technical refers to the adaptation of systems or tools required for implementation and operation.

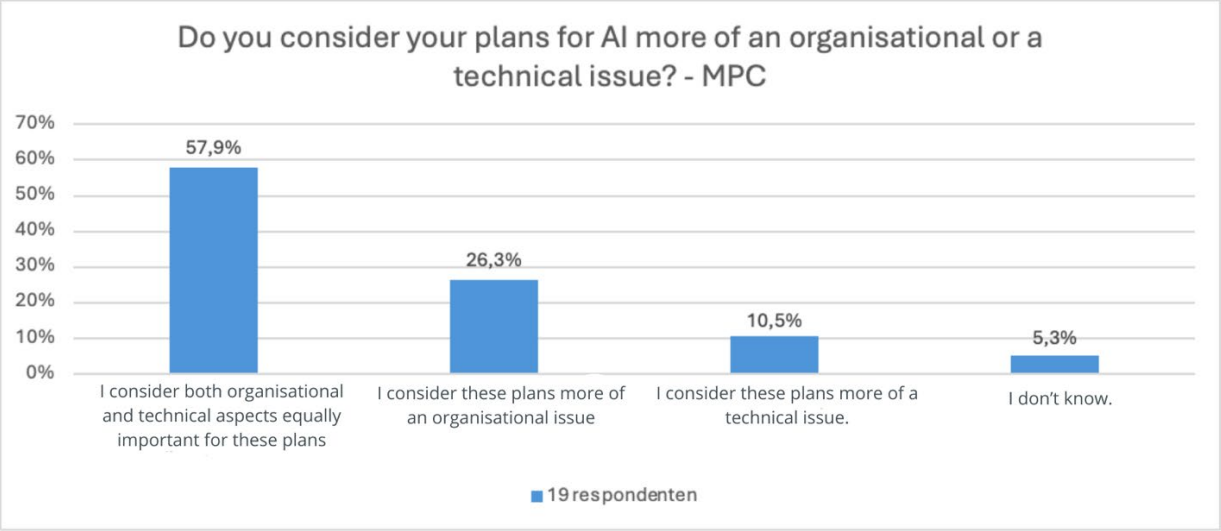


Figure 1: Responses on organisational vs technical issue

3.1.2 Looking at These Results, What Stands out?

The choice that an AI project is considered equally organisational and technical is clearly the outlier. Following that, the choice that respondents view an AI project more as an organisational issue comes next. These results show that 84.2% (57.9% + 26.3%) of respondents see an AI project (in part) as an organisational issue. This does not align with the research from Boston Consulting Group and MIT Sloan Management Review (Stackpole, 2022).

Although no general conclusion can be drawn in comparison to these results, this does not mean that the findings are irrelevant. On the contrary, it can be concluded that it is valuable to identify whether a client views an AI project as a technical or organisational issue. This is not always obvious, as clients may have different views on the nature of the issue.

3.2 Level of Commitment

3.2.1 Pilot/Experiment/Proof-of-concepts

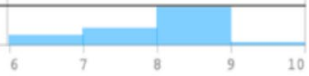
Before companies want to implement a new innovative idea, it is common to conduct a pilot/experiment/proof-of-concept (PoC). To investigate the outcomes and the level of success of this, the following question was posed to respondents who indicated they had conducted an experiment or pilot: What were the results of the experiments or pilots you conducted in the field of AI? (open-ended question)

Table 1: Responses on themes of experiments

Themes from Experiment Results	Number	Percentage
Valuable use of AI	4	36,40%
Learning process	3	27,30%
Positive impact on employees	2	18,20%
Awareness at management level	1	9,10%
Not successful	1	9,10%
Total number of respondents	**11**	**100%**

The follow-up question to this was: How successful was this experiment or pilot? 1 being not successful, 10 being highly successful.

Table 2: Responses on successfulness experiments

Variable	Count	Average	Median	
Drag the slider to give your score...	12	7,50	8	

3.2.2 Interpreting These Results

What stands out is that the average success rating is 7.5, and the results from the frequency table indicate that AI experiments mainly provide value and learning experiences (see the top table). However, a limited group still faces obstacles with AI. From this, it appears that most AI experiments are successful among these participants.

Looking at scientific research, this conclusion is not surprising. According to scientific articles, proof-of-concepts (PoCs), pilot projects, and experiments conducted within the AI project world are often considered successful. (Kutz, Neuhüttler, Spilski, & Lachmann, 2022)

However, it is important to note that a successful PoC, pilot, or experiment does not necessarily indicate a successful AI implementation project.

AI technologies that are actually implemented in practice are rare. Most AI projects fail. Estimates suggest that the failure rate is around 80%—almost double that of IT projects within companies a decade ago. (Bojinov, 2023) (de Bellefonds & Charanya, 2024)

3.3 Stage of Development

The development stage of a company is crucial for understanding the change processes organisations undergo. We used the theory of The Adaptive Cycle of Resilience (Abcouwer et al., 2020; Takács & Abcouwer, 2020) to illuminate these processes. Since organisational change is not the core topic of our research, this theory fulfilled our requirements, and we did not further explore the available change management theories (Lauer, 2021) (Smith, Jones & Brown, 2005) (Hiatt & Creasey, 2003). The model identifies the different phases of resilience that a company can experience. However, it is difficult to determine from the survey which phase the respondent's company is in. Given these limitations, the following can be examined:

To investigate whether companies want to work with AI and are therefore resilient, the following question was posed: Does your company have plans to do something with AI?

Table 3: Responses on Company Plans to Implement AI

Does your company have plans to do something with AI?	Number	Percentage
Yes, we already use it.	13	60,9%
Yes, we have plans	7	30,4%
Not that I know of.	1	4,3%
No, we have no plans.	1	4,3%
Total	21	100%

3.3.1 Interpreting These Results

More than half of the companies are already using AI, while 30.4% plan to implement it in the future. This indicates that a significant number of organisations are either already applying AI or considering its use, highlighting the growing relevance of this technology.

This also aligns with scientific research, which shows that more than 80% of companies worldwide are already using or considering implementing AI. (University, 2024) (Chauhan, 2024).

3.4 Context and Stakeholders

The context of certain roles. Not everyone can explain AI in the same way. This paragraph will explore whether there are correlations between certain stakeholders and how they view AI or become involved with AI.

3.4.1 Opportunities and Threats per Context

To investigate the correlation between the perception of opportunities and threats, and the role, the following question was asked: Could you mention the opportunities and threats of adopting AI as you see them? (open-ended question).

Looking at these results, what stands out?

Since not all roles provided multiple responses, only the CEO, IT Manager, and Project Manager are analysed.

- **CEO**: CEOs approach AI from a strategic level, seeing opportunities in improving efficiency and innovation. At the same time, they remain cautious about risks such as loss of control and ethical issues. Their focus is therefore on value creation and risk management.
- **IT Manager**: IT managers see AI as an opportunity for efficiency and quality improvement. At the same time, they perceive threats related to cybersecurity risks, the need for human control, and low accessibility for employees with less digital skills.
- **Project Manager**: Project managers primarily view AI as a tool for improving efficiency, gaining new insights from large amounts of data, and delivering services faster with fewer errors. However, they are concerned about ethical issues, the risk of inaccurate data leading to incorrect conclusions, and the impact on employment. This reasoning can be linked to what is needed to maintain a project.

As far as our research shows, this approach has not yet been explored in full detail.

3.5 Who do the Respondents Consider the Best Contact Person?

To investigate which role customers believe is most suitable for assessing the needs and opportunities related to AI within their organisations, the following question was presented to the respondents: "Whose opinion within your company do you find the most and least important when an AI project is being carried out? Please rank the roles in order of importance (with the most important at the top)."

The answers to this question resulted in the following outcome: How often each role was ranked in positions 1-2-3:

Table 4: Responses on most and least valued opinions in AI projects

Job titles	CEO	CTO	CSO	CFO	HRM	R&D	Job title that is not listed in this row
Top tier (positions 1–2–3)	76,2%	90,5%	28,6%	23,8%	19,0%	33,3%	28,6%
Bottom tier (positions 4–5–6)	23,8%	9,5%	71,4%	76,2%	81,0%	66,7%	71,4%

How often a role was ranked in position 1:

Table 5: Roles most frequently ranked 1 in AI project decision-making

Job titles	CEO	CTO	CSO	CFO	HRM	R&D	Job title that is not listed in this row
1st place	38,1%	33,3%	0,0%	0,0%	0,0%	9,5%	19,0%

Table 6 indicates the position where the role was most frequently placed.

Table 6: Overview of most frequently ranked roles per position

Ranking Based on 21 Responses							
Variable	1	2	3	4	5	6	7
Chief Executive Officer (CEO)	8	6	2	5	0	0	0
Chief Technology Officer (CTO)	0	2	3	6	5	5	0
Chief Sales Officer (CSO)	0	1	5	1	6	6	2
Chief Financial Officer (CFO)	7	7	5	2	0	0	0
Human Resource Manager	0	2	2	3	7	5	2

Ranking Based on 21 Responses							
Research and Development manager	2	2	3	4	3	5	2
Job title not listed in this row	4	1	1	0	0	0	15

3.5.1 Interpreting These Results

According to these respondents, the CEO and CTO are the most important roles within the company for an AI project. This is evident both from the number of times they ranked first and the chart. There is no direct scientific source that addresses this specific topic for comparison. However, there is a source on how to identify the decision-maker within a company best. This focuses primarily on the role and function within the company, the company's needs, and the specific challenges that need to be solved. (Shekhar, 2024) (Redlawsk & Lau, 2009) (Payne, Bettman & Luce, 1998)

3.6 How a Provider of AI technology Sells an AI Tool

3.6.1 Explanation of Customer Needs

Different sales techniques can be chosen to explain the added value of AI for its sale.

To investigate what customers truly need for the explanation of AI, the following question was posed to the respondents: "How can an AI provider best explain the added value of their solution to you? (multiple answers possible)."

The answers to this question resulted in the following outcome:

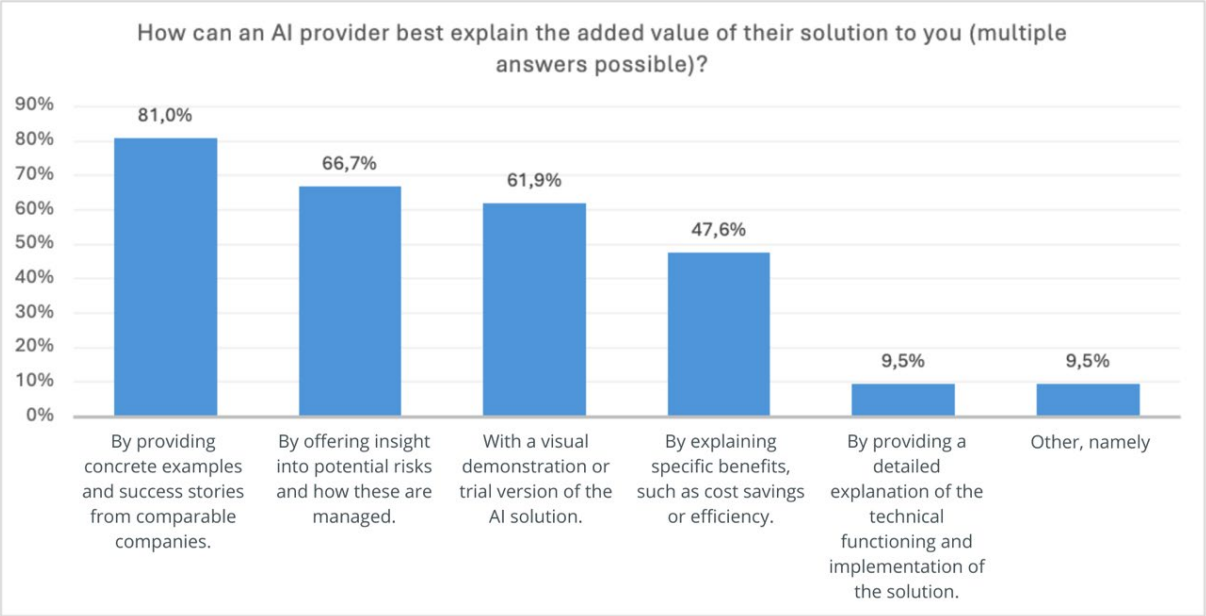


Figure 3: ways AI providers can best communicate added value

3.6.2 Interpreting These Results

The results show that customers primarily seek an explanation that emphasises the practical side of an AI project. This includes:

- Most notably: through concrete examples and success stories from similar companies.
- By providing insight into potential risks and how they are managed.
- With a visual demonstration or trial version of the AI solution.
- By explaining specific benefits, such as cost savings or efficiency improvements.

What stands out is that detailed explanations about the technical functioning and implementation of the AI solution were barely selected. Only two respondents indicated a need for this technical explanation, both of whom were an IT manager and a CEO/director.

Interestingly, three IT managers and six CEOs/directors filled out the survey, but only one of these two groups chose to request technical details. Based on this limited group of respondents, this suggests that a technical background or high leadership role does not necessarily mean one desires technical details. Therefore, no direct conclusion can be drawn that roles with a technical background or leadership position automatically require an in-depth explanation of how an AI tool functions.

A scientific study by Gartner (no date) confirms the finding about what kind of explanation is desired in such projects. It shows that it is most effective to explain what these technological solutions can mean for the client. Preferably, by providing social proof in the form of customer success stories and real-world examples. Additionally, it's crucial to outline a realistic approach that leads the buyer from their current situation to the desired future state (Gartner, no date). In short: sell the solution, not the technology. Preferably to those who view AI as strategically important. Provide evidence that the solution works and sketch a realistic implementation path.

4. Conclusion and Recommendations

Based on the findings, the following conclusions and advice can be compiled for companies offering AI tools.

4.1 Type of Customers

An AI tool often impacts multiple processes within a company. Research and interviews with professionals reveal two types of customers:

- **Customers with concrete AI plans:** These customers have already crafted clear plans for implementing AI and approach the AI provider with specific goals in mind.
- **Customers without concrete AI plans:** These customers do not have established plans for AI or are uncertain about its use, necessitating the AI provider to proactively engage with them to explore potential opportunities.

4.1.1 Customers With Concrete AI Plans

For the first type of customer, the CEO, CTO, or data manager are often the appropriate points of contact. These customers already have plans in place, so the AI provider only needs to focus on explaining how the AI tool can assist in realising those plans. The challenges the customer is facing are already clear.

4.1.2 Solution Selling

For this type of customer, it is recommended to identify the challenge the company wants to solve and demonstrate how the AI tool can address it using solution selling. Avoid providing a detailed explanation of the technical side of AI and instead focus on:

- Examples and success stories
- Moving from the current situation to the desired outcome
- Visual demonstrations
- Providing insights into potential risks

It is advised against conducting Proof of Concepts (POCs) to clarify the functioning of the AI tool. Research shows that around 80% of AI projects fail after a POC. Furthermore, a POC extends the sales cycle, leading to inefficiencies and a higher risk of implementation failure.

It’s important to note that the examples, risks, demonstrations, or scenarios may vary per company or industry.

4.1.3 Customers Without Concrete AI Plans

For the second type of customer, identifying the appropriate contact person is more difficult. Ideally, urgency should be fostered among the operational staff and managers within the company so that they can ultimately persuade the CEO or the board of directors. Therefore, it is crucial that there is no sales-oriented communication with the CEO or board in the early stages of the process. The chances of AI project failures increase when

unrealistic or unfeasible projects are proposed. For these customers, it is essential to first raise awareness of the issues within multiple layers of their organisation.

This process begins by answering the "why" question: why does this problem exist, what problems are there, and why is it important to solve them? Only then should it become clear how the AI tool can solve this problem and what the specific solution entails.

It is crucial that the AI tool is not presented as a solution until the "why" question has been answered. The customer must first fully understand what the problem is, and then the AI tool should be presented as the solution.

This method is inspired by Simon Sinek's Golden Circle model (Sinek, 2009) (Straker & Nusem, 2019)

4.2 How to Approach of Customers

4.2.1 The Questionnaire

When the customer has not or limited AI plans available we should help them to explore the opportunities for AI application. To help customers identify the problem (and thus answer the "why" question), a questionnaire has been created. This questionnaire helps the salesperson clarify where there are opportunities for the AI tool/application:

- Which processes take the most time?
- How much workforce is being spent on these processes?
- Does data play a significant role in these processes?

The salesperson does not need to ask these questions literally, but it is recommended to follow this approach during the conversation.

4.2.2 Solution Selling – Dealing With the Outcomes

Once the organisational problem that needs to be addressed is clear, solution selling comes into practice.

Based on these questions, solution selling will provide:

- Examples and success stories
- From the current to the desired situation
- Visual demonstration
- Insights into potential risks

And avoid Proof of Concepts (POCs), as we have seen before.

4.3 Flowchart

The theory does not always align perfectly with practice. Therefore, to ensure that this information is in line with real-world practices, it is recommended to answer and record the following questions in the CRM system for each sale, whether successful or unsuccessful:

- In which industry is this company active?
- Who is the right contact person within the company?
- Was the solution-selling methodology used in the sales process?
- Have certain success stories or examples proven to be more effective than usual? If so, which ones?

This will continuously improve this document and potentially uncover connections between specific industries and the best ways to approach them for a sales opportunity. To capture this approach, a flowchart has been created to visualise the research outcomes.

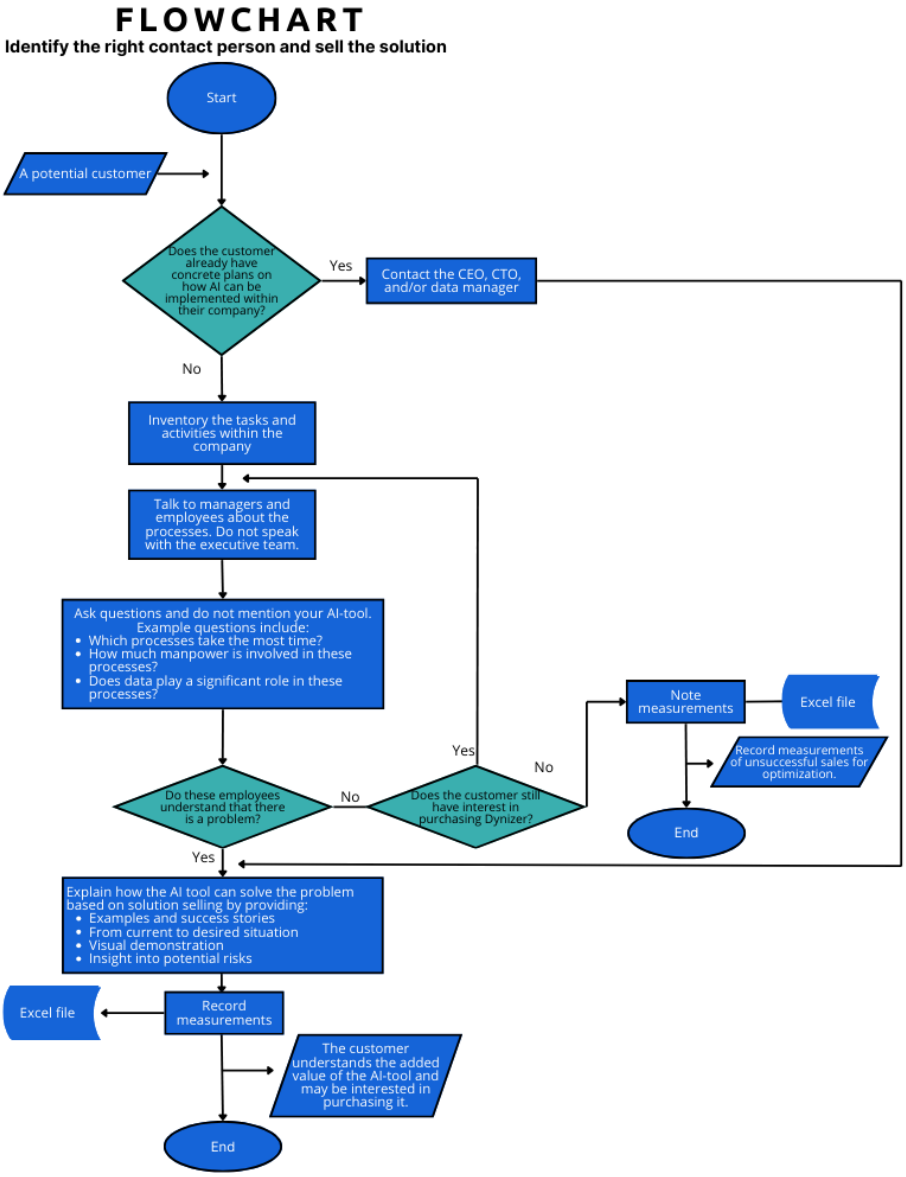


Figure 4: Flowchart

4.3.1 Why Does the Flowchart Have two Endpoints?

Because the process leads to different outcomes depending on whether the customer eventually shows interest in the AI tool or not. If the customer is not interested, a different route is followed than if they are.

Once the customer understands the added value of the AI tool, it is crucial to make them aware of the nature of the issue they are facing. This primarily involves an organisational issue. Research shows that customers often perceive AI as a technical problem, while its implementation heavily depends on organisational adjustments and collaboration within the company.

5. Ethical Declaration

For this research, information has been collected that in some cases may be traceable to specific individuals. However, this data has been processed anonymously and has been used solely for research purposes. All respondents were informed in advance about the purpose of the study and how their data would be used. They gave their consent for participation.

No personal data has been shared with third parties, and all data has been handled with care and in accordance with applicable privacy and ethical guidelines.

AI Declaration

This research makes use of ChatGPT, an AI tool from OpenAI, to support the writing process by improving translation, enhancing readability, rephrasing content, and shortening sections of text. The content has been entirely determined by the author, with ChatGPT serving as a supportive tool. All generated output has been carefully reviewed and adjusted where necessary.

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Mapping the Intellectual Structure of Digital Entrepreneurship Field with Strategic Diagram

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Abstract: The convergence of digital technologies and entrepreneurship has given rise to a new phenomenon known as digital entrepreneurship. Despite growing interest, limited research has explored the intellectual structure and trends within this field. To address this gap, this study aims to map the intellectual structure and trends in digital entrepreneurship field utilizing co-word analysis. The authors searched for English-language articles published between 2006 and 2024 in the Web of Science Core Collection and Scopus databases, using the key phrase 'digital entrepreneur*'. 311 unique keywords were identified and clustered into eight groups via modularity clustering. A two-dimensional map based on cluster density and centrality reveals four cluster types: central and developed, peripheral and developed, peripheral and underdeveloped, central and underdeveloped—offering insights into the field's evolving intellectual landscape.

Keywords: Digital Entrepreneurship, Intellectual Structure, Co-word Analysis, Strategic Diagram, Mapping

1. Introduction and Theoretical Background

Digital technologies, considered one of the most influential and disruptive developments since the Industrial Revolution, have significantly reshaped the world (Dana et al, 2024). The widespread adoption of digital technologies and the availability of internet infrastructure everywhere have enabled the emergence of a new type of entrepreneurship called digital entrepreneurship (Abubakre et al, 2021). Digital entrepreneurship is seen as a new model that integrates digital technologies with entrepreneurial opportunities (Li et al, 2024). As a form of entrepreneurship that deeply changes economic growth, the shape of real economies, and the structure of industries (Liu et al, 2024) it has become increasingly important today and continues to attract attention as a current topic in both practice and research (Kollmann et al, 2022).

Considering the growth and importance of this field, it is crucial to understand the current state and emerging trends of digital entrepreneurship. Dana et al (2023) presented a quantitative mapping of digital entrepreneurship through a bibliometric analysis of its publications. They found the field of digital entrepreneurship to be rather lively and in rapid development. Lungu et al (2024) mapped the field of digital entrepreneurship through a systematic and integrative review of research published between 1989 and February 2023 in the Web of Science, using both quantitative and qualitative methods. Liu et al (2025) adopted bibliometric and content analysis methodologies to systematically examine the field of digital entrepreneurship. Their results revealed a recent surge in interest in digital entrepreneurship, highlighting its significant potential. Although research on the development and evolution of digital entrepreneurship field is growing, it remains evident that further in-depth studies are required to advance the field. Especially investigating the thematic clusters in this field and analysing the maturity of the subject are essential steps. To address this gap, this study aims to map the intellectual structure and trends in digital entrepreneurship field utilizing co-word analysis. The following sub-research questions were addressed:

Q1. How is the intellectual structure of digital entrepreneurship field analysed in terms of top co-word pairs, co-occurrence matrix, and modularity clustering?

Q2. How are the clusters of digital entrepreneurship field visualized and analysed by the strategic diagram in terms of density and centrality of clusters?

To achieve the aim and answer the sub-questions, English-language articles published between 2006 and 2024 in the Web of Science Core Collection and Scopus databases were identified using the key phrase 'digital entrepreneur*'. A co-word matrix was generated based on the co-occurrence frequency of the keywords. Applying modularity clustering to this matrix resulted in eight clusters representing the intellectual structure of the literature for the period 2006–2024. Additionally, a two-dimensional map was created to visualize the structure of these clusters, considering both their density and centrality. This analysis allowed to identify four

types of clusters: central and developed, peripheral and developed, peripheral and underdeveloped, central and underdeveloped.

2. Methodology

Co-word analysis is used to explore a research topic a given research field through the co-occurrence of keywords extracted from the corpus of documents (Cobo et al, 2011; Hosseini et al, 2025). Co-word analysis has two assumptions: first, that the keywords used in a document are carefully selected by its author and accurately reflect the document's meaning and content; second, that the co-occurrence of two keywords in different documents indicates a correlation (Feng et al, 2017). Co-word analysis is based on the principle that the co-occurrence of keywords reflects the content of documents. This technique allows researchers to identify distinct research areas in specific disciplines (Callon et al, 1991). It also helps to uncover significant and hidden patterns, explore internal and external relationships between concepts, and detect emerging trends (Hosseini et al, 2025). Therefore, a co-word analysis was conducted to identify the intellectual structure and trends within digital entrepreneurship field.

In this research, the first step was to extract keywords from English-language articles published between 2006 and 2024 in the Web of Science Core Collection and Scopus databases. The second step involved generating a co-word matrix based on the co-occurrence frequency of the keywords. The third step included building a modularity cluster (Blondel et al, 2008) and measuring the density and centrality of each cluster in order to create a strategic diagram. Figure 1 indicates four areas of strategic diagram include (Soriano-Pinar et al, 2023; Han et al, 2013):

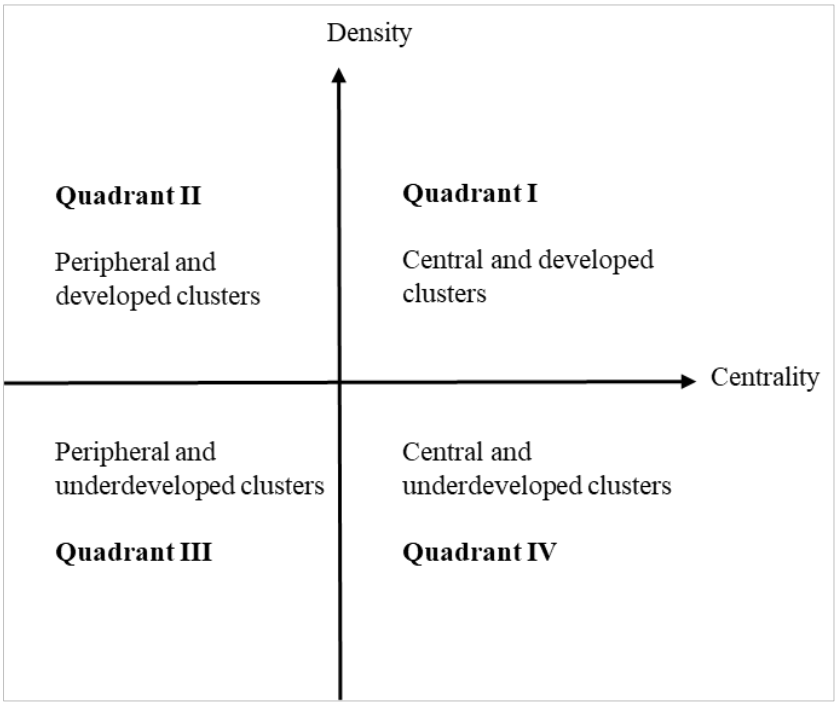


Figure 1: Strategic diagram and characterization of clusters

- Central and developed clusters represent the driving themes of the field, which are well developed and important for its structure. These themes define the focus and emphasis of the research field.
- Peripheral and developed clusters represent the themes that are well developed but are of only marginal importance for the field. These themes are very specialized and peripheral in character.
- Peripheral and underdeveloped clusters represent the themes that are unstructured and weakly developed. Themes represent either emerging or disappearing topics.
- Central and underdeveloped clusters represent the themes that are underdeveloped but have the potential to become core and promising lines of research.

2.1 Data Collection and Pre-processing

In co-word analysis, after selecting a research area, keywords are extracted from relevant journal articles or other publications. A co-occurrence matrix is then constructed, where each cell value indicates the frequency with which two keywords appear together.

The authors searched for English-language articles published between 2006 and 2024 in the Web of Science Core Collection and Scopus databases, using the key phrase 'digital entrepreneur*' to query the fields of Title, Abstract, and Author Keywords. A total of 399 articles were retrieved from the Web of Science database and 468 articles from Scopus database. After manually filtering out duplicates and irrelevant articles (214), articles with no keywords or one keyword (29), and articles with two keywords (2), 622 articles and 3,451 keywords were obtained (Figure 1).

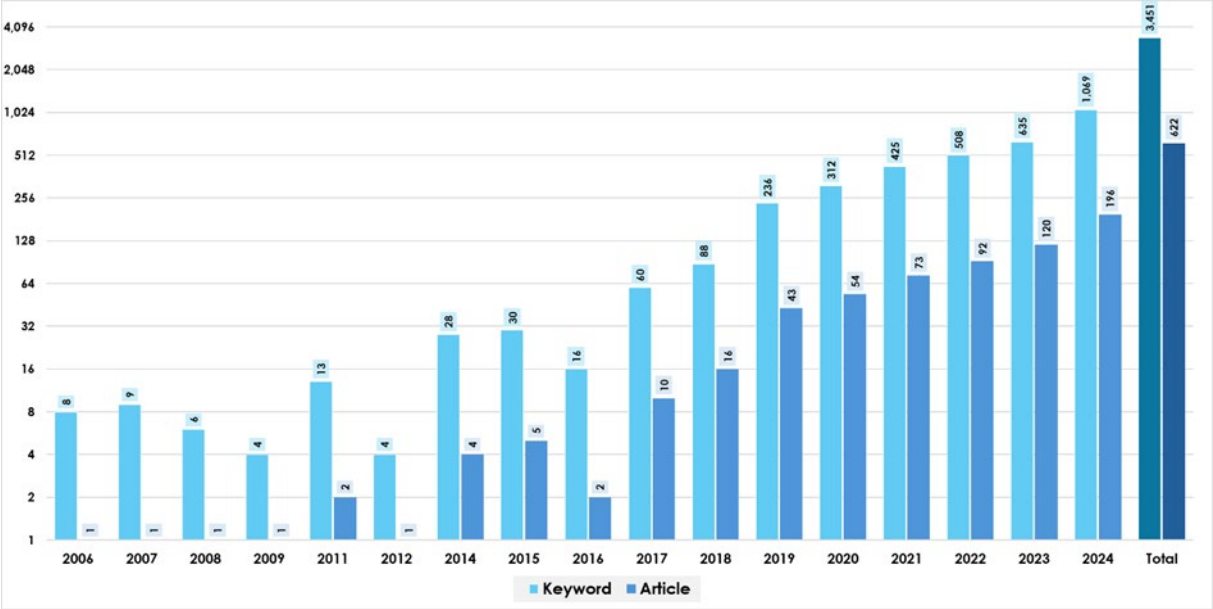


Figure 2: The number of keywords and articles covering the term of 2006-2024

Note: Logarithmic 2 scale is used. N (Keyword)=3,451, N (Article)=622

A total of 3,451 keywords were analysed, 1,539 of which were identified as unique. Based on Bradford's Law (Angammana and Jayatissa, 2015; Khasseh et al, 2017), thresholds were defined using co-occurrence frequency of the keywords. A total of 311 unique keywords with a co-occurrence frequency of ≥10 were selected for the final analysis, representing Zones 1 and 2 and accounting for 62% of the total keyword co-occurrence.

2.2 Data Analysis

A co-word matrix was formed based on the co-occurrence frequency of the 311 unique keywords. The clusters were then identified using modularity clustering in Gephi 0.10.1 (Bastian et al., 2009). Afterward, a separate co-occurrence matrix was constituted for each cluster. Finally, the density and centrality of each cluster were measured by using UCINET 6.801 (Borgatti et al, 2002) and strategic diagram was drawn.

3. Results

The list of top thirty keywords according to the frequency and co-occurrence frequency is presented in Table 1.

Table 1: The top thirty keywords of frequency and co-occurrence frequency

ID	Frequency		Co-occurrence Frequency	
	Keywords	f	Keywords	f
1	Digital entrepreneurship	305	Digital entrepreneurship	1,408
2	Entrepreneurship	97	Entrepreneurship	500
3	Digitalization	45	Digitalization	230
4	Digital transformation	40	Digital transformation	207
5	Digital technology(ies)	36	Digital technology(ies)	187

ID	Frequency		Co-occurrence Frequency	
	Keywords	f	Keywords	f
6	Digital entrepreneur(s)	31	Innovation(s)	166
7	Digital entrepreneurial ecosystem(s)	31	Digital entrepreneur(s)	145
8	Innovation(s)	30	Digital innovation(s)	144
9	Digital innovation(s)	28	Startup(s)	136
10	Startup(s)	27	Digital entrepreneurial ecosystem(s)	130
11	Social media	25	Social media	120
12	Digital entrepreneurial intention(s)	24	Entrepreneurial ecosystem(s)	119
13	Entrepreneurial ecosystem(s)	24	Digital economy	108
14	Digital startup(s)	23	Digital platform(s)	106
15	Digital economy	22	COVID-19	100
16	Digital platform(s)	22	Digital entrepreneurial intention(s)	98
17	COVID-19	20	Digital startup(s)	93
18	Technology	19	Technology	91
19	SMEs	18	China	89
20	Artificial intelligence (AI)	17	Ecosystem(s)	89
21	China	17	Artificial intelligence (AI)	88
22	Ecosystem(s)	17	SMEs	86
23	Entrepreneurial intention	17	Digital	82
24	Bibliometric analysis	16	Business model(s)	77
25	Business model(s)	15	Entrepreneurial intention	75
26	Case study	15	Case study	72
27	Digital	15	Theory of planned behaviour	71
28	Theory of planned behaviour	15	Data	70
29	Women entrepreneurship	15	Internet	68
30	Network(s)	13	Women entrepreneurship	68

Scrutinizing the results in Table 1, the frequency ranks from the first to the fifth belonged to Digital entrepreneurship (305), Entrepreneurship (97), Digitalization (45), Digital transformation (40) and Digital technology(ies) (36), respectively. As shown in Table 1 the co-occurrence frequency ranks from the first to fifth belonged to Digital entrepreneurship (1408), Entrepreneurship (500), Digitalization (230), Digital transformation (207) and Digital technology(ies) (187), respectively.

Table 2 shows the results of the modularity clustering with the keywords contained in each cluster. 311 keywords were divided into eight clusters. Keywords in each cluster reflect the corresponding research topics, as well as the research directions of digital entrepreneurship field. As the biggest cluster, Cluster1 comprises 142 keywords. As the smallest clusters, Cluster7 comprises 3 keywords.

Table 2: The cluster of the keywords

Cluster ID	Number of Keywords	Keywords	Most Important First Three Keywords in the Clusters (Degree)
1	142	Academic entrepreneurship, Agent-based analysis model, Automotive industry, Beijing, Bibliometric analysis, Born digitals, Bricolage, Business development, Business model canvas, Business model change, Business model innovation, Business model(s), Capability(ies), Case study, City(ies), Co-creation, Community(ies), COVID-19, Creativity, Crowdfunding, Cyberpreneurship, Data, Decision making, Demand-side perspective, Digital business(es), Digital capability, Digital competency(ies), Digital disruption, Digital economy, Digital entrepreneurship, Digital environment, Digital innovation ecosystem, Digital innovation(s), Digital marketing, Digital platform(s), Digital services, Digital skills, Digital startup(s), Digital strategy, Digital technology(ies), Digital transformation, Digital venture(s), Digitalization, Digitization, Disruptive innovation, Disruptive technology(ies), Dynamic capability(ies), Economic disruption, Economic growth, Education, Effectuation, Emerging market(s), Emerging technology(ies), Entrepreneurial agility, Entrepreneurial alertness, Entrepreneurial behaviour, Entrepreneurial finance, Entrepreneurial firm(s), Entrepreneurial intention, Entrepreneurial journey, Entrepreneurial marketing, Entrepreneurial orientation, Entrepreneurial passion, Entrepreneurial process, Entrepreneurialism, External enabler(s), Financing, FSQCA, Gig economy, Globalization, Growth, Guanxi, Handicrafts, Higher education, India, Industry 4.0, Informal economy, Information, Information and communication technology, Innovation(s), Innovativeness, Institutional theory, International business, International entrepreneurship, Internationalization, Internet startup(s), Labour, Latin America, Lean startup(s), Literature review, Management, Mobile applications, Music entrepreneurship, Neoliberalism, Network(s), New venture(s), Nigeria,	Digital entrepreneurship (522), Digitalization (172), Digital technology(ies) (150)

Cluster ID	Number of Keywords	Keywords	Most Important First Three Keywords in the Clusters (Degree)
		OECD, Opportunity recognition, Pivoting, Platform economy, Platform(s), Policy(ies), Proactiveness, Process model, Quality, Research and development, Resource-based theory, Risk taking, Science, Self-efficacy, Sharing economy, Small business(es), SMEs, Social capital, Social entrepreneurship, Social media platforms, Social network(s), Social sustainability, Socioeconomic, South Africa, Stakeholder, Startup(s), Strategy(ies), Structural equation modeling, Sustainability, Sustainable entrepreneurship, Sustainable performance, Systematic literature review, Technological innovation, Technology, Technology acceptance model, Technology affordance theory, Training, Unicorns, Value proposition, Venture capital, Virtual reality, Vosviewer, Wechat, Women entrepreneur(s), and Women entrepreneurship	
2	20	Africa, Big data analytic(s) capabilities, Central and Eastern Europe, Creative industries, Digital ecosystem(s), Digital entrepreneurial ecosystem(s), Digital entrepreneurial orientation, Digital organizational culture, Digital society, Entrepreneurial ecosystem(s), Entrepreneurial opportunity(ies), Financial inclusion, Fintech(s), Ghana, Human capital, Incubator(s), Leadership, Mobile money, Transnational digital entrepreneurship, and Value creation	Entrepreneurial ecosystem(s) (104), Digital entrepreneurial ecosystem(s) (80), Digital ecosystem(s) (44)
3	42	Attitudes, Blockchain, ChatGPT, Continuance intention, Digital entrepreneur(s) competency(ies), Digital entrepreneurial behavior, Digital entrepreneurial intention(s), Digital entrepreneurial knowledge, Digital entrepreneurial opportunity(ies), Digital entrepreneurial self-efficacy, Digital entrepreneurship education, Digital literacy, Digital social entrepreneurship, Electronic word of mouth, Emerging economies, Entrepreneurial knowledge, Entrepreneurial learning, Entrepreneurial self-efficacy, Entrepreneurship education, Family business, Indonesia, Intention, IT-enabled capabilities, Jordanian, Malaysia, Massive open online course(s), Moderated mediation model, Perceived behavioural control, Perceived ease of use, Perceived usefulness, Performance expectancy, Personality trait(s), Resilience, Saudi Arabia, Social cognitive career theory, Student(s), Subjective norms, Theory of planned behaviour, Uncertainty, University students, User satisfaction, and Youth(s)	Digital entrepreneurial intention(s) (80), Entrepreneurship education (60), Saudi Arabia (60)
4	7	Business innovation, Business performance, Crisis, Cultural and creative industry(ies), Digital adoption, Music industry, and Russia	Business innovation (18), Crisis (18), Digital adoption (18)
5	82	Algorithms, Application, Artificial intelligence (AI), Barriers, Big data, Business, China, Cluster(s), Communication, Competitiveness, Creative labour, Crowdsourcing, Culture, Customer behaviour, Cyberfeminism, Cybertraders, Definitions, Developing countries, Digital, Digital enterprise, Digital entrepreneur(s), Digital labour, E-business, E-commerce, E-entrepreneurship, Egypt, Electronic commerce, Enterprise, Entrepreneur(s), Entrepreneurship, Ethnography, European Union, Facebook, Feminist theory, Framework, Gender, Generation Z, Healthcare, High-quality development, Influencer(s), Informal sector, Institutions, Internet, Internet of things, Intersectionality, Italy, Kuaishou, Machine learning, Metaverse, Micro small and medium-sized enterprises, Microenterprises, Migration, Modeling, Online business, Online entrepreneurship, Online platform(s), Open innovation, Opportunity(ies), Parasocial interaction theory, Performance, Productive entrepreneurship, Professionalization, Purchase intentions, Qualitative method(s), Regression analysis, Skill(s), Smart city(ies), Social media, Social media influencers, Sport(s), Success factors, Sustainable development, Sustainable development goals, Technology entrepreneurship, Text analysis, Tourism, Trust, University(ies), Virtual enterprise, Web, Women, and Youtube	Entrepreneurship (292), Digital entrepreneur(s) (122), Social media (96)
6	7	Digital citizenship, Digital governance, Digital infrastructure, Ecosystem(s), Information technology(ies), Matchmakers, and Multisided platforms	Ecosystem(s) (86), Information technology(ies) (38), Multisided platforms (28)

Cluster ID	Number of Keywords	Keywords	Most Important First Three Keywords in the Clusters (Degree)
7	3	Innovative education, Online courses, and Online education and training	Innovative education (12), Online courses (12), Online education and training (12)
8	8	Home-based business, Homeworking, Identity, Liminality, Live streaming, Persons with disabilities, Remote work, and Self-employment	Identity (24), Home-based business (22), Liminality (18)
Total	**311**		

Figure 2 shows a strategic diagram generated according to the centrality and density of clusters. This reveals the status and trends of current digital entrepreneurship field by dividing the eight clusters into four quadrants. In the strategic diagram, the horizontal axis reflects the centrality of the clusters, representing the strength of interaction between the analysed clusters. The higher a centrality of cluster, the more essential and central its position. The vertical axis shows the density of clusters, representing their own internal relations. The greater the density of a cluster, the greater its capacity to maintain and develop itself (Liu et al, 2012; Khasseh et al, 2017).

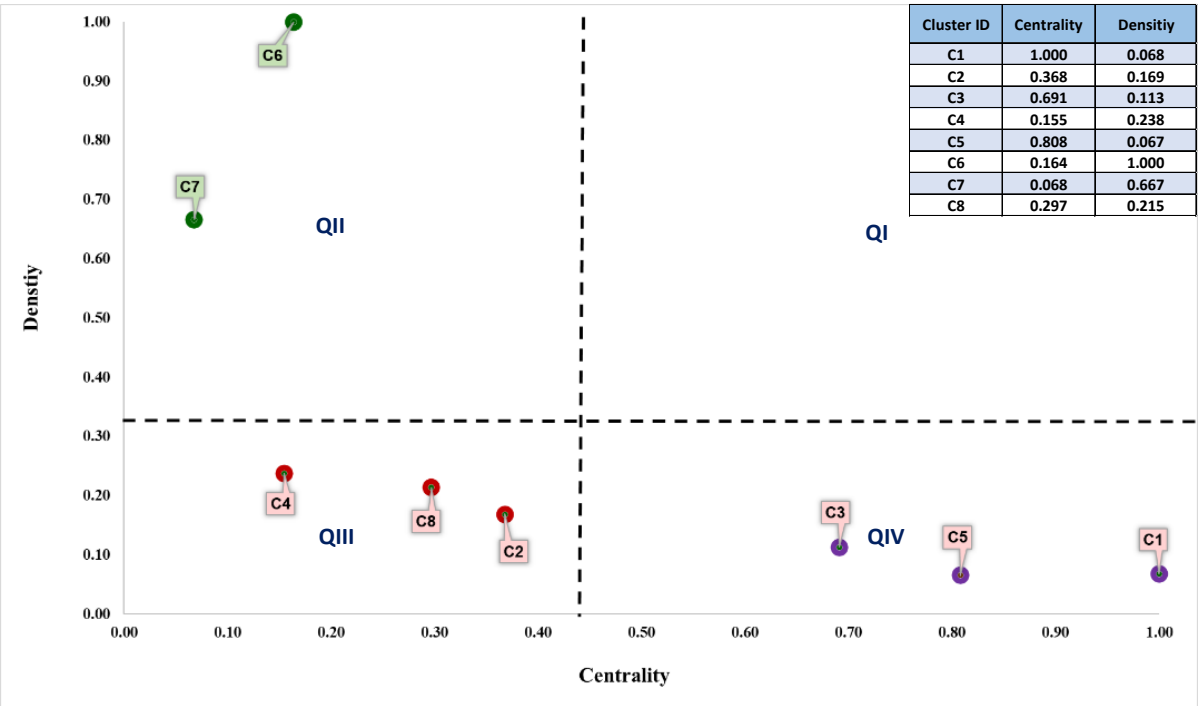


Figure 2: Strategic diagram of the eight clusters

Note: The mean values (x = 0.444, y = 0.317) were used to plot the lines of the strategic quadrants that intersect the two axes.

As can be seen in Figure 2, Quadrant I (QI) does not include any clusters. Quadrant II (QII) includes Cluster6 and Cluster7 which have a high density and low centrality. The high density indicates that the research topics in these two clusters are well-developed and mature. However low centrality indicates that the research topics are isolated. Quadrant III (QIII) includes Cluster2, Cluster4 and Cluster8. Their low density and centrality reveal that the research topics in these clusters are marginal and immature. Quadrant IV (QIV) includes Cluster1, Cluster3 and Cluster5 which have high centrality but low density. This implies that these clusters are well connected to other clusters, and that the topics within them are at the centre of discussion but undeveloped.

4. Discussion and Conclusion

This study maps the intellectual structure and trends within the digital entrepreneurship field. It highlights key research areas and the relationships between different topics, presenting clear and logical findings on the current state and trends in the field.

The five keywords with the highest co-occurrence frequency are Digital entrepreneurship, Entrepreneurship, Digitalization, Digital transformation, and Digital technology(ies). This means that these keywords are commonly used and recognised in the core of studies in this field. Consequently, they have received a large share of the discussions in this field.

According to modularity clustering, eight clusters were identified and divided into four quadrants based on cluster centrality and density. Interestingly, no cluster is placed in Quadrant I, which contains central and developed clusters. The absence of clusters in this quadrant suggests that the digital entrepreneurship field is still in its infancy and has considerable potential for growth.

Quadrant II includes Cluster6 and Cluster7, which are described as peripheral and developed. These themes have become more specialized and separated from the main themes of the field of study. In the Cluster6 Ecosystem(s), Information technology(ies), and Multisided platforms; in the Cluster7 Innovative education, Online courses, Online education and training are the first three keywords with the highest degree centrality, making them important topics in their cluster (Baskici and Gokmen, 2024). Cluster7 can be considered an outcome of the COVID-19 pandemic, which forced people to work and study from home.

Cluster2, Cluster4 and Cluster8 are located in Quadrant III, which indicates their peripheral and underdeveloped status. The topics included in these themes could be the focus of researchers' attention due to their marginal status and lack of development. The first three keywords with the highest degree centrality in Cluster2 are Entrepreneurial ecosystem(s), Digital entrepreneurial ecosystem(s), and Digital ecosystem(s); in Cluster4 they are Business innovation, Crisis, and Digital adoption; and in Cluster8 they are Identity, Home-based business, and Liminality. Of these clusters, Cluster2 is particularly noteworthy. Digital entrepreneurship is a relatively recent phenomenon. However, it requires an ecosystem in which to develop. While research into such ecosystems is still in its infancy, this cluster suggests that one is beginning to emerge.

Quadrant IV includes Cluster1, Cluster3 and Cluster5, which are described as central and underdeveloped. Quadrant IV lists topics with the potential to become mainstream research trends. The first three keywords with the highest degree centrality in Cluster1 are Digital entrepreneurship, Digitalization, and Digital technology(ies); in Cluster3 they are Digital entrepreneurial intention(s), Entrepreneurship education, and Saudi Arabia; and in Cluster5 they are Entrepreneurship, Digital entrepreneurs, and Social media.

This study has several limitations. Firstly, the analyses were conducted based on the keywords of the articles. Other academic documents were not included in the study. Including these in future research could broaden the scope of the analysis and provide a more comprehensive understanding of how the field has developed. Secondly, the analyses were conducted for a single period. Future studies could include sub-periods in their analyses. This would enable the observation of development and changes in the field over the years.

Ethics Declaration

Ethical review not required because of using secondary data.

AI Declaration

An AI tool was not used in the development of the paper.

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Leveraging Technology for Sustainable Growth: An Analysis of Micro, Small, and Medium, Enterprises (MSMEs) in Iloilo Province during the Post-Pandemic Milieu

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Abstract: This research examined how MSMEs in Iloilo Province adopted digital transformation during the post-pandemic era. Adopting narrative inquiry, data were gathered using focus group discussions, online interviews, and surveys among 25 owners and managers of MSMEs in both rural and urban settings. Through the Technology–Organization–Environment (TOE) framework, the research identified drivers and challenges of digital adoption. Participants explained experiences applying e-commerce sites, mobile apps, and automation software to keep businesses going. By analyzing cases of Panublion Handicrafts, Farm to Kariton, and Innovate Iloilo, the study emphasized sector-specific innovations and adaptations. Results indicated that digital technologies increased customer interaction, operational efficiency, and market exposure, amidst financial challenges and limited infrastructure. The research provides policy insights for policymakers, development actors, and support institutions that seek to enhance MSME resilience and inclusive digital development in provincial environments.

Keywords: Digital Transformation, MSMEs, Post-Pandemic Recovery, Narrative Inquiry, Technology Adoption

1. Introduction

MSMEs are the lifeblood of developed and developing economies alike, representing about 90% of all businesses and providing over half of all employment worldwide (World Bank, 2020). MSMEs role was amplified in developing economies, not only to contribute significantly to economic activity but are also critical to innovation, regional development, and ensuring an even distribution of income (Cueto et al.2022; OECD,2017). In the Philippines, MSMEs account for 99.52% of businesses and 63% of employment, enhancing inclusive entrepreneurship and regional resilience (DTI, 2018). MSMEs also enhance inclusive entrepreneurship and community resilience, especially for the underprivileged and geographically scattered areas.

Today, being relevant and competitive requires more than the traditional means of conducting business. Digitalization has become a vital strategy for MSMEs to streamline operations, reach wider markets, and adapt to a dynamic consumer behavior (Mazzarino, 2020; Porter & Heppelmann, 2014). Even before the outbreak of the COVID-19 pandemic in the Philippines, a strong trend had already been noted among MSMEs as they adopted digital technology, driven by policies that promoted technological innovation and provided access to digital resources (Asia-Pacific MSME Trade Coalition, 2019; Dinh et al., 2020).

The pandemic hastened the shift. The Philippine economy shrunk by 9.5% in 2020, a stark witness to the impact of the pandemic (Asian Development Bank, 2020; Blanza, 2023). Due to thin margins, MSMEs were vulnerable. Many suffered in revenue decrease, supply chain disruption and witnessed consumer demand plunge. These vulnerabilities created an urgent necessity for digital transformation, and businesses responded by shifting to e-commerce, adopting contactless transactions, enforcing remote work arrangements, and strengthening online customer service (Priyono et al., 2020; Sharma & Rai, 2023; Gumasing, 2022). More than just operational changes, these shifts signify fundamental reimagining of business practices.

Iloilo Province, Philippines offers a compelling topic for investigation. Its blend of rural and urban economies presents rich microcosms of opportunities and challenges in digital transformation. Despite their resilience, many MSMEs in the province face barriers like poor infrastructure, low digital literacy, and uneven policy enforcement (UP Visayas, 2018). Additionally, the province's rich economic heritage and strong MSME profile offer a valuable context for exploring digital transformation amid economic and cultural diversity.

To systematically explore these dynamics, this study uses Tornatzky and Fleischer's (1990) TOE approach. This framework allows for a systematic exploration of digital adoption of MSMEs, considering internal capabilities and resources within the Organization Context, external pressures and opportunities in the Environment Context, and the nature of the technologies within the Technology Context. Applying the TOE framework to Iloilo's MSMEs, this research aligns with digital transformation best practices while highlighting an often-overlooked context.

There is dearth in literature on MSMEs especially in provincial regions like Iloilo. Likewise, most studies are focusing on large companies which have more resources and have already built digital infrastructures. Moreover, while various studies examine immediate reactions after the pandemic, few investigate long-term recovery approaches and the continuous adoption of digital practices. It is with this study that we attempt to address two critical gaps: the lack of empirical focus on MSMEs in less-urbanized settings in the Philippines and the limited application of holistic frameworks like TOE in these situations. Through this initiative, the study provides insights and recommendations for MSME stakeholders by mapping Iloilo's digitalization journey, highlighting key challenges, enablers, and innovations to inform sustainable regional and national planning.

1.1 Objectives of the Study

This study aims to evaluate the post-COVID 19 digital technology adoption by MSMEs in Iloilo Province, providing a roadmap for sustainable growth and future resilience. Specifically, the study aimed to achieve the following objectives:

1. To determine baseline level of technological integration among MSMEs in Iloilo before and after the onset of the pandemic;
2. To challenges and barriers did these enterprises encounter during their digital transformation journey;
3. To identify the notable successes, innovations, and best practices that have been embraced by MSMEs in Iloilo's digital transformation;
4. To provide actionable insights and recommendations that can be derived from the study's findings to enhance support for the digital evolution of MSMEs in the Iloilo region.

2. Review of Related Literature

2.1 Digital Transformation and MSMEs

Digitalization drives MSME competitiveness by streamlining operations, enhancing customer experience, and opening new markets in today's tech-driven economy (Bharadwaj et al., 2021; OECD, 2021). Current studies demonstrate that MSMEs that utilize digital solutions are significantly faster and more adaptive to market changes (Vial, 2019; Kane et al., 2023). This shift was accelerated by COVID-19 pandemic, forcing MSMEs to rely on digital solutions ensuring business continuity during worldwide disruptions (World Bank, 2022; UNCTAD, 2021).

Digitalization enables MSMEs overcome the constraints of market access, enabling remote work, digital payments, and customer insights through data (Li, Liu, & Zhao, 2021). Automated inventory, customer support online, and social media marketing are now critical tools in sustaining businesses, particularly in locations where resources are scarce (Balida et al, 2022). However, the success of transformation often rests on the ability of an MSME to adjust, their awareness and degree to which digitalization was embedded in their strategic considerations (Sharma & Rai, 2023).

2.2 Impacts of the Pandemic on MSMEs Globally and Regionally

COVID-19 exposed MSME vulnerabilities, including revenue losses, supply disruptions, and closures (ILO, 2022). In Southeast Asia, tourism, food, and retail, among others, experienced severe declines, through mobility restrictions and changes in demand (ASEAN, 2021). To recover, MSMEs shifted to digital models, emphasizing online sales, virtual services, and contactless transactions. (OECD, 2022).

In the pandemic's first year, Philippine MSME e-commerce registrations rose by 45% (DTI, 2022). This growth shifted digital tools from support roles to essential drivers of MSME development and resilience (Saarikko, Westergren, & Blomquist, 2020). Digitally adopting MSMEs rebounded and innovated better, but gaps in access and tech capability persist (Abdelrahim et al., 2023).

2.3 Barriers and Enablers to Digital Transformation

Despite their potential, digital adoption by MSMEs is hindered by financial, skill, and infrastructure gaps (Balida, 2024), particularly in underdeveloped areas (Verma et al., 2023; World Bank, 2022). MSMEs often lack formal IT strategies, and decision-makers may be hesitant due to perceived complexity and cybersecurity risks (Mazzarino, 2021). Digital uptake is boosted by enablers like tax incentives, upskilling programs, and infrastructure support

from the government (OECD, 2022; DTI, 2022). Furthermore, the rising demand for digital transactions and marketplaces creates new revenue opportunities for MSMEs, while tech partnerships and digital ecosystems boost access to innovation and support (Parviainen et al., 2020; Hou et al., 2020).

2.4 Outcomes of Digital Transformation

Westergren, Holmström, and Mathiassen (2022) emphasized that effective digital adoption brings MSMEs key benefits like efficiency, cost savings, and customer loyalty, driven by data-informed decisions and real-time services. Meanwhile, e-commerce drives MSME internationalization, reducing reliance on physical stores (UNCTAD, 2021). On the other hand, automation, AI forecasting, and CRM systems enhance MSME agility and scalability, especially in volatile times (Bughin et al., 2020; Kane et al., 2023). Digital innovation also fosters continuous learning and adaptation. However, these gains require sustained investment, strategic planning, and supportive institutions (Sharma & Rai, 2023).

2.5 Case-Based Insights into MSME Digital Adaptation

Iloilo MSMEs show how digital innovation addressed pandemic challenges, offering sector-specific insights beyond broad global trends. One classic example is how Panublion Handicrafts, used social media, virtual workshops, and online partnerships to stay afloat during hard hit by the pandemic. These efforts retained local customers and opened global markets, showing how heritage firms can thrive through digital innovation (Lopez, 2022; Ong, 2021). In the agricultural space, Farm to Kariton swiftly adopted mobile apps and local logistics to go direct-to-consumer, bridging supply gaps and building a loyal base, proving digital models work for perishables (Santos, 2021; Villanueva, 2022). Finally, Innovate Iloilo, a tech incubator, used digital platforms to sustain and grow its ecosystem through virtual mentorships and global webinars, expanding partnerships despite lockdowns (Reyes, 2021; Tan, 2022). These concrete field examples reflect broader research linking digital agility to MSME resilience (UNCTAD, 2022; OECD, 2021) and underscore the TOE framework's value in explaining how environments shape digital adoption.

3. Methodology

3.1 Research Design and Methods

This study adopted a qualitative approach using narrative inquiry, to explore how MSMEs in Iloilo Province traversed the volatile path of digital transformation during the COVID-19 crisis. The research design yielded rich insights into MSME stakeholders' experiences, strategies, and perceived enablers and barriers (Creswell & Poth, 2018). Narrative inquiry and the art of meaning making were used to deeply explore business transformations through MSME owners' and managers' personal stories (Clandinin, 2016). To enrich data and broaden scope, the study used a mixed-method design with structured questionnaires, enabling theme development, trend analysis, and data triangulation (Fetters et al., 2013). It also applied the TOE framework to assess the fit between internal capabilities, external pressures, and technology use (Tornatzky & Fleischer, 1990).

3.2 Population and Sampling

Using purposive and snowball sampling, the study targeted MSME owners and decision-makers, e.g., operations or marketing manager, actively involved in or responsible for digital transformation projects during or after the pandemic. This criterion ensure that the information obtained reflected both strategic and operational perspectives toward digital uptake (Palinkas et al., 2015). The study involved 25 participants, 10 in two face-to-face focus groups and 15 in Zoom interviews, balanced between urban and rural MSME owners from sectors like food, handicrafts, agri-business, retail, and digital services. See Table 1 for details.

Table 1: Distribution of Participants

Data Collection Method	Population Criteria	Number of Participants
Face-to-Face Focus Group	MSME owners/managers (urban/rural)	10
Online Interviews	MSME owners/managers (urban/rural)	15
Total		**25**

3.3 Data Collection Methods

Data were collected using two qualitative methods: (1) face-to-face focus group discussions and (2) web-based semi-structured interviews from January to March 2024. The focus groups were organized in collaboration with local chambers and business enterprise centres, which helped connect the researchers with verified MSME operators. Each 90-minute session explored shared experiences, challenges, and coping strategies and was audio-recorded with participants' informed consent. Semi-structured online interviews, lasting about 45 minutes each, accommodated participants in various locations or those unable to attend in person. Interviews focused on digital adoption drivers, challenges, and operational shifts.

A pre-interview survey was distributed to all participants, collecting data on demographics, digital technology use, business size, and perceived post-pandemic performance. This two-mode approach enabled methodological triangulation and enhanced internal validity (Bryman, 2016). Ethical protocols were implemented including informed consent, assurance of anonymity, and participants' right to withdraw at any time.

3.4 Data Analysis

The interview transcripts were analysed using thematic analysis and axial coding to reveal emerging themes and identify underlying patterns. The reviews of the three cases (Panublion Handicraft, Farm to Kariton, and Innovate Iloilo) supported the findings by emphasizing into the challenges they encountered and the successes they reached. Comparative analysis of different cases drew out the similarities and differences in their challenges and digital solutions. This methodology provided a rich understanding of MSMEs' experiences, as well as useful insights into their adaptation strategies in a constantly changing digital landscape.

4. Findings and Discussion

This section presents key themes from the experiences of Iloilo MSMEs during and after the pandemic. Drawing from interviews, surveys, and case narratives, it highlights major challenges, digital strategies, and outcomes. The findings offer insights into how MSMEs adapted, innovated, and transformed in response to a rapidly changing business environment.

Table 2: Can you describe the most significant challenges your business faced during and after the pandemic?

Challenge Themes	Specific Issues Encountered
Financial Strain	Reduced revenue and profitability
	Cash flow and liquidity concerns
	Increased operational costs
	Difficulty accessing financial support
Adaptation and Digital Transformation	Swift transition to remote work
	Initial hurdles in adopting digital tools
	Shortage of technological skills
	Balancing online and offline strategies
Supply Chain Disruptions	Delays in sourcing raw materials
	Logistic challenges and transportation issues
	Inconsistencies in supplier deliveries
	Increased costs due to scarcity of goods
Workforce and Employee Well-being	Remote work challenges
	Employee burnout and mental health concerns

Challenge Themes	Specific Issues Encountered
	Maintaining productivity in remote setup
	Addressing health and safety concerns

Table 2 highlights the complex challenges Iloilo MSMEs faced during the post-pandemic period. Financial strain marked by revenue loss, cash flow issues, and limited access to support was widespread (OECD, 2020). The shift to digital platforms introduced integration hurdles and skill gaps (Cueto et al., 2022). Disrupted supply chains and rising input costs compounded operational difficulties (UNCTAD, 2021). Remote work further intensified concerns around productivity, mental health, and employee well-being (ILO, 2021), reflecting the multifaceted nature of MSMEs' adaptation struggles.

Table 3: How did technology play a role in overcoming these challenges?

Challenge	Role of Technology
Financial Strain	Online platforms expanded customer reach. Digital payment systems enabled contactless transactions. Automation improved operational efficiency. Online financial platforms eased loans' access.
Adaptation and Digital Transformation	Collaborative tools supported remote work. Webinars bridged the skills gap. Online courses build digital skills. Hybrid models offer customer flexibility
Supply Chain Disruptions	Supply chain software enabled real-time tracking/sourcing. logistics platforms optimized deliveries. Communication tools improved suppliers coordination.
Workforce and Employee Well-being	Collaboration software kept remote teams connected. Well-being apps addressed mental health concerns. Project management tools sustained remote productivity. Health apps supported work place safety.

Table 3 underscores the vital role of digitalization in addressing MSME challenges. Online platforms and digital payments stabilized revenues (OECD, 2020), while automation reduced operational costs (World Bank, 2021). Remote collaboration tools and online training mitigated skill gaps and supported virtual operations (ILO, 2021). Hybrid models allowed flexibility in service delivery (UNCTAD, 2021). Supply chain issues were addressed through real-time tracking and AI-driven inventory systems (PwC, 2020). Workforce well-being was supported by digital tools promoting communication, productivity, and health. As Cueto et al. (2022) note, digitalization is now a core strategy for resilience and growth, not merely a technological upgrade.

Table 4: Were there any technologies or digital strategies that proved exceptionally beneficial for your business?

Theme	Technologies or Strategies
Innovations in Sales and Marketing	E-commerce Platforms, Social Media Advertising, Influencer Collaborations
Operational Efficiency and Automation	Inventory Management Software ,CRM Systems , Automated Workflows
Customer Engagement and Experience	Personalized Email Campaigns ,Live Chat Support , Customer Feedback Platforms
Supply Chain Optimization	Real-time Tracking and Monitoring, Supplier Collaboration Platforms Demand Forecasting Tools
Remote Work and Collaboration	Video Conferencing Tools, Cloud-based Collaboration Suites Virtual Team Management Tools

Table 4 shows that MSMEs use digital tools to boost visibility, streamline operations, and engage customers. E-commerce and social media drive sales (OECD, 2020), while CRM and automation enhance efficiency (World Bank, 2021). Tools for customer interaction and supply chain tracking improve responsiveness (UNCTAD, 2021; PwC, 2020). Remote work is supported by collaboration platforms, reinforcing that digital adoption improves both business performance and customer experience (Cueto et al., 2022).

Table 5: What motivated you to adopt or resist certain technological tools or platforms?

Themes	Sub-Themes	Motivations/Resistance Factors
Business Needs and Goals	Improving Customer Engagement	Primary driver for technology adoption
	Enhancing Operational Efficiency	Motivated adoption to streamline processes
	Expanding Market Reach	Desire to reach new markets fueled adoption
Resource Constraints	Budget Limitations	Limit and restrict adoption
	Limited Technical Expertise	Skills gap hindered adoption
	Time and Resource Allocation	Resources constraints influence choices
Perceived Benefits	Potential for Increased Revenue	Significant motivator for adoption
	Competitive Advantage	Desire to stay ahead drove adoption
	Improved Customer Experience	Improved engagement encourage adoption
Technological Literacy	Willingness to Embrace Innovation	Openness supported adoption
	Lack of Familiarity or Comfort	Resulted in resistance to adoption
	Training and Skill Development	Adoption depended on training

Table 5 shows that MSMEs adopt digital tools to improve engagement, efficiency, and market reach (Vial, 2019; Bharadwaj et al., 2021). However, barriers like cost, limited skills, and resource gaps persist, especially in provincial areas (Balida, 2024; Verma et al., 2023). Motivators include revenue growth and competitiveness, while adoption is influenced by digital literacy and training access (Sharma & Rai, 2023; Abdelrahim et al., 2023), aligning with the TOE framework's focus on organizational and environmental factors (Tornatzky & Fleischer, 1990).

Table 6: How has digital transformation positively impacted customer engagement?

Themes	Sub-Themes	Notable Observations
Successful Implementations	Improved Customer Engagement	Improved customer interactions.
	Enhanced Operational Efficiency	Processes became more efficient.
	Expanded Market Reach	New markets were reached.
Challenges Faced	Technical Hurdles	Technology integration was challenging.
	Change Management	Transition management was difficult.
	Resource Constraints	Limited sources slowed progress.
Lessons Learned	Importance of User Adoption	User buy-in was essential to success.
	Need for Adequate Planning	Planning was crucial for success.
	Continuous Learning and Adaptation	Continuous adoption was needed.

Table 6 shows that MSMEs pursue improved engagement, efficiency, and market reach through digital tools. However, they face challenges in technology integration, change management, and limited resources (Verma et

al., 2023; Balida, 2024). As noted by Sharma and Rai (2023), success depends on user buy-in, strategic planning, and adaptability to evolving digital trends.

Table 7: How supportive or challenging did you find the environment (e.g., local regulations, customer behaviors, competition) in Iloilo for your digital transformation efforts?

Environmental Factors	Themes	Responses' Observations
Supportive Factors	Local Regulatory Support	Supportive policy aided transformation.
	Customer Behavior and Demand	Customers embraced digital offerings.
	Collaboration and Networking	Local networking boosted efforts.
Challenging Factors	Complex Regulatory Landscape	Complex regulations created barriers.
	Limited Digital Literacy	Digital unfamiliarity limited adoption.
	Intense Competition	Market competition was intense.
	Infrastructure Constraints	Poor infrastructure slowed progress.

Table 7 shows that Iloilo MSMEs face both enablers and barriers to digital transformation. Supportive policies, customer openness, and collaboration drive adoption (OECD, 2022), while complex regulations, low digital literacy, and weak infrastructure hinder progress (Balida, 2024; Verma et al., 2023). These factors shape the region's digital landscape and affect MSME success.

Table 8: What advice would you offer to other MSMEs in Iloilo about leveraging technology for growth?

Themes for Successful Technology Integration	Key Advice for MSMEs
Operational Tips	Start small and scale gradually; Train employee continuously.
Customer Focus	Focus on customer needs and engagement.
Strategic Planning	Align technology with business goals; Stay updated and adaptive to trends.
Collaboration	Build network and collaborate; Explore partnerships
Risk Management	Prioritize cybersecurity and privacy; Establish contingency plans to mitigate risks.

Table 8 presents key strategies for tech-driven growth. Starting small, investing in training, and focusing on customer needs improve adoption (Saarikko et al., 2020). Aligning technology with business goals, monitoring trends, and fostering collaboration enhance resilience and innovation (Sharma & Rai, 2023). To mitigate risks, MSMEs must prioritize cybersecurity, data privacy, and backup systems—critical safeguards in digital integration (Mazzarino, 2021; Abdelrahim et al., 2023).

Table 9: Spotlight on Innovative MSME Entities in Iloilo Post-Pandemic

Entity	Background	Challenge	Adaptation	Outcome
Panublion Handicrafts	Traditional crafts with modern designs	Tourism decline	Boosted online presence: social media, workshops, e-commerce	Retained local clients, gained international buyers
Farm to Kariton	Organic produce supplier	Disrupted supply chains	Direct-to-consumer model via mobile apps, community partnerships	Increased loyal subscribers, positive local impact
Innovate Iloilo	Tech start-up hub	Loss of on-site interactions	Online mentorships, virtual networking, global webinars	Expanded global reach, increased overseas collaborations

Table 9 highlights how three Iloilo MSMEs adapted through digital innovation. Panublion Handicrafts used social media and e-commerce to retain local clients and attract international buyers (Lopez, 2022; Ong, 2021). Farm to Kariton adopted mobile platforms and local partnerships to address supply gaps and grow its customer base (Santos, 2021; Villanueva, 2022). Innovate Iloilo shifted to virtual mentorships and global webinars, expanding

reach and collaboration (Reyes, 2021; Tan, 2022). These cases reflect broader findings that link digital agility to MSME resilience and competitiveness (UNCTAD, 2022; OECD, 2021).

Table 10: Digital Adoption Rates among MSMEs in Iloilo

Digital Adoption Metric	Percentage of MSMEs
Adoption of at least one digital tool	82%
Online presence (websites, e-commerce)	70%
Use of digital marketing strategies	65%
Integration of digital payment systems	58%

Table 10 presents survey data on digital adoption among MSMEs in Iloilo during the post-pandemic period. Findings reveal that 82% of respondents adopted at least one digital tool, 70% established an online presence, 65% used social media marketing, and 58% integrated digital payments. These trends signal a strong shift toward digitalization, driven by changing consumer behavior and the need for operational resilience (UNCTAD, 2021; Abdelrahim et al., 2023). As digital platforms became essential for business continuity, MSMEs leveraged them to improve efficiency, expand reach, and meet evolving market demands (OECD, 2022; Sharma & Rai, 2023).

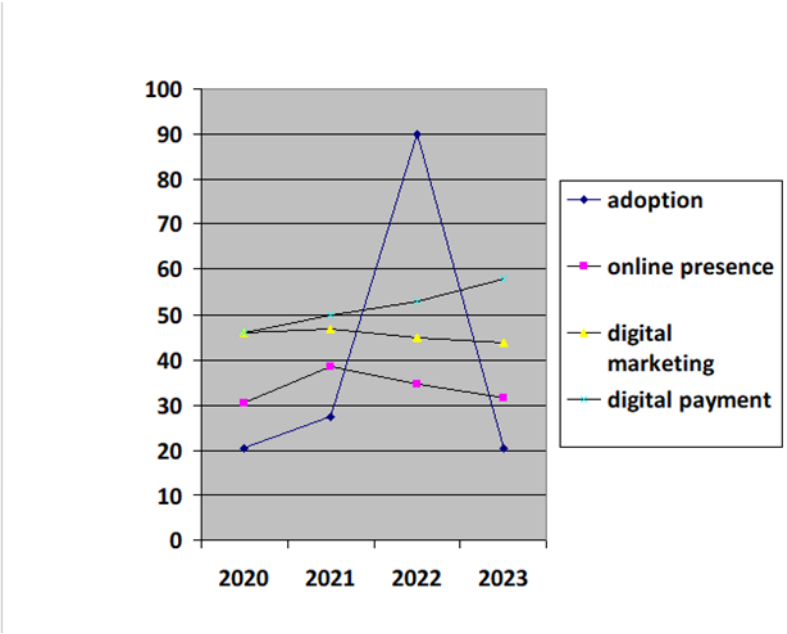


Figure 1: Line Graph Illustrating Digital Adoption Rates among MSMEs in Iloilo

Figure 1 illustrates the steady rise in digital adoption among Iloilo MSMEs from 2020 to 2023, marking their strategic pivot to technology-enabled operations in response to pandemic disruptions.

5. Implications of the Overall Findings

The study shows that digital transformation among Iloilo's MSMEs has evolved from a reactive measure into a strategic approach reshaping how businesses operate, compete, and grow. Early adoption of digital tools—particularly in marketing, sales, and payment—demonstrates a strong shift toward digital integration with policy and regional development implications.

Findings highlight the need for stronger institutional support, including improved internet access in rural areas and advanced training in data analytics, cybersecurity, and e-commerce. MSMEs can drive regional recovery if equipped with digital finance access, tailored mentorship, and sector-specific support. Given varying levels of digital maturity, localized and context-driven interventions are essential.

Using the TOE framework, the study emphasizes that digital uptake is influenced by internal capacities, external pressures, and technological availability. Despite challenges, MSMEs are poised for innovation, provided they operate within an enabling ecosystem. A collaborative strategy involving government, academe, and industry is crucial to sustain inclusive, tech-enabled growth.

6. Conclusion and Recommendations

This study examined how MSMEs in Iloilo Province accelerated digitalization in response to the COVID-19 pandemic. Most enterprises adopted at least one digital tool, primarily online platforms, digital marketing, and cashless payments, reflecting a strategic shift in operations and customer engagement. Rather than temporary responses, these changes indicate deeper integration of digital practices. However, adoption remains uneven due to infrastructure gaps, limited digital skills, and fragmented policy support, particularly in rural areas.

To promote inclusive digital transformation, expanding broadband—especially in underserved areas—through public-private partnerships is crucial. Capacity-building must go beyond basic digital skills to include cybersecurity, data analytics, and e-commerce, in collaboration with universities, NGOs, and development agencies. Enhanced financial support through tax breaks, grants, and loans can enable MSMEs to invest in digital tools and formalize operations. Collaborative platforms for marketing and knowledge-sharing can foster peer learning and collective growth. A coordinated effort among government, academe, and industry is vital to build a resilient digital ecosystem.

Finally, agency like the DTI and local councils should implement evidence-based monitoring systems to track digital adoption and adjust policies accordingly. Collectively, these measures can create a resilient, inclusive, and innovation-driven MSME sector, where digitalization becomes a long-term strategy for sustainable growth beyond the pandemic.

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Crowdfunding for University Research Commercialization: A Scoping Review

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Abstract: As universities take on a broader role beyond education and research, crowdfunding is emerging as a creative way to fund research commercialization and academic entrepreneurship. Crowdfunding not only provides financial support but also serves as a validation tool, demonstrating public demand for university-led innovations. It serves as a potential alternative to traditional funding avenues, especially for early-stage projects with commercial promise. This scoping review examines key themes in the growing body of literature on research crowdfunding, focusing on its role in academia, motivations and success factors, public engagement, and associated challenges. The extent to which universities actively support, regulate, or discourage crowdfunding varies widely, shaping its effectiveness as a commercialization pathway. Crowdfunding success depends significantly on entrepreneurial communication skills and public engagement. Researchers who craft compelling narratives, leverage social media, and highlight the broader impact of their work are more likely to attract funding. Studies indicate that campaigns tied to practical applications, industry relevance, or endorsements from credible institutions often outperform those relying solely on scientific merit. Another critical aspect is how crowdfunding democratizes access to research funding, offering the public a say in which projects receive financial backing. However, current evidence suggests that it tends to attract an audience already interested in science and innovation, rather than drawing in broader investor networks. Crowdfunding does not fully replace more established pathways such as venture capital, government grants, or university-led incubators. Despite its promise, crowdfunding presents distinct challenges in academic commercialization. Researchers must navigate concerns over intellectual property, project credibility, and the significant time commitment required for campaign success.

Keywords: Crowdfunding, University Research Commercialization, Knowledge Transfer, Academic Entrepreneurship

1. Introduction

Universities are under growing pressure to translate research into commercial and societal benefits, even as traditional research funding becomes harder to secure. In response, many institutions are investing in research commercialization—the process of turning academic discoveries into marketable innovations, typically through mechanisms such as technology transfer, licensing, spin-off creation, and industry partnerships, often managed by Technology Transfer Offices (Siegel et al., 2003; Wright et al., 2007; Perkmann et al., 2013). While the linear commercialization model remains dominant, it is capital-intensive, time-consuming, and often inaccessible to early-stage researchers and smaller institutions, particularly those outside established entrepreneurial ecosystems (Etzkowitz and Leydesdorff, 2000). As public funding for science stagnates and competition increases, alternative funding mechanisms are being explored. Among these, crowdfunding has emerged as a novel avenue to raise small-scale funds while also enhancing public engagement.

Crowdfunding refers to the process of raising small amounts of capital from a large number of individuals via online platforms to fund a project, product, or venture (Belleflamme et al., 2014). Originally developed in creative and entrepreneurial contexts, crowdfunding has expanded across sectors. It is commonly categorized into four models: donation-based (contributions without expectation of return), reward-based (contributors receive a product or service), lending-based (peer-to-peer loans), and equity-based (contributors receive ownership stakes). Crowdfunding also has gained attention as a novel source of research funding and early-stage commercialization capital in academia (Siva, 2014). Over the past decade, a growing body of literature has explored these issues in various contexts; yet, no comprehensive review has synthesized these findings.

This scoping review aims to map the state of knowledge on crowdfunding for university research commercialization. Arksey and O'Malley's (2005) scoping review framework was followed to identify and summarize relevant studies. The following three key research questions were addressed:

1. How are universities adopting crowdfunding in their research and commercialization strategies?
2. What factors influence the success or failure of research crowdfunding campaigns?
3. What barriers and challenges to research crowdfunding are identified in the literature?

In addition, the trends over time in this literature, the geographic distribution of studies, the types of crowdfunding models (donation, reward, equity) discussed, and the reported outcomes or impacts of crowdfunding in the academic context were examined. The goal of this scoping review is to inform researchers

and university stakeholders of the opportunities and limitations of crowdfunding as a tool for research commercialization, and to highlight areas requiring further investigation.

2. Methodology

This scoping review was conducted following the scoping study methodology by Arksey and O'Malley (2005). This process involved five stages: (1) identifying clear research questions (as stated above); (2) identifying relevant studies through comprehensive literature searches; (3) selecting studies based on inclusion criteria; (4) charting the data; and (5) collating, summarizing, and reporting the results.

2.1 Search Strategy and Selection

Academic databases Scopus and Web of Science as well as the AI tool Research Rabbit were used for searching the relevant publications from 2010 to the present moment that discussed crowdfunding in a university or academic research context. The search key string used was TITLE-ABS-KEY ("crowdfunding" AND ("research" OR "academic research") AND ("commercialization" OR "technology transfer" OR "academic entrepreneurship" OR "university spin-offs")). To be included, sources had to explicitly address crowdfunding as it relates to universities (e.g., use by university researchers or for university projects) and provide empirical findings or substantial analysis pertinent to the research questions. The peer-reviewed articles, conference papers, book chapters, and SSRI papers in English were included. After screening titles and abstracts and removing duplicates, 30 sources were deemed eligible and were fully reviewed.

2.2 Data Extraction and Synthesis

The key information from each paper was extracted on the excel sheet, including publication year, study context (region), type of crowdfunding model examined (donation, reward, equity), methodology, and the main findings relevant to university adoption, success factors, and challenges. A qualitative thematic analysis was performed to identify common themes and patterns across the studies. The results are organized into a descriptive overview of the literature and thematic sections corresponding to the research questions. The summary tables (Tables 1 and 2) were also compiled to highlight recurring success factors and challenges reported in the literature.

3. Results

A total of 30 publications were included in this review, spanning the years 2013 to 2023. Early discussion of academic crowdfunding began around 2013-2014 (Wheat et al. 2013; Siva 2014), and the number of studies has grown over time, with notable increases in the late 2010s (see Figure 1 below for details). Geographically, research on this topic has been led by authors in North America and Europe, with some contributions from Australia and Asia, and limited representation from Africa (see Figure 2 below for geographical distribution). Methodologically, the literature comprises case studies (often detailing single university crowdfunding initiatives), surveys of academics or backers, analyses of crowdfunding campaign datasets, and commentary pieces.

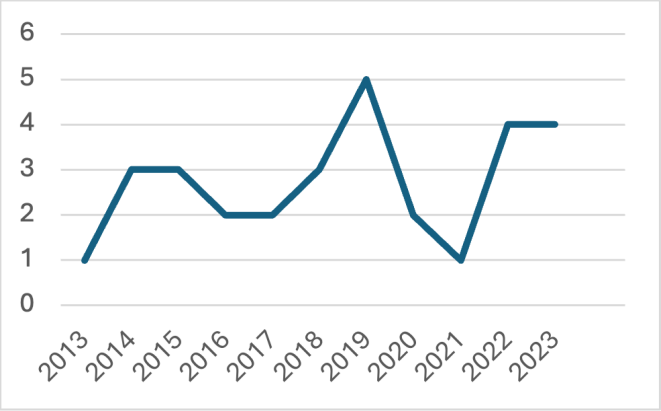


Figure 1: Number of papers by year

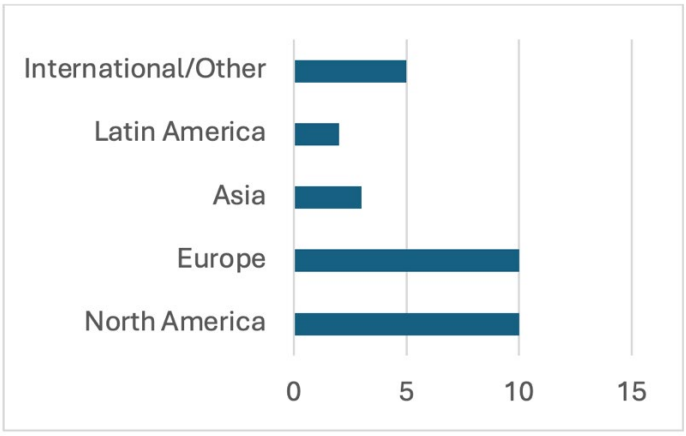


Figure 2: Number of papers by region

3.1 Crowdfunding Adoption by Universities

Universities have generally been cautious in adopting crowdfunding as part of their commercialization strategies. In many cases, initiatives have been driven bottom-up by individual researchers or small teams rather than through university-wide programs (Verhoeven and Palmer 2015; O'Donnell 2021). Some universities have experimented with pilot crowdfunding programs (Verhoeven and Palmer 2015) or set up their own crowdfunding portals though Horta et al. (2021) found that less prestigious universities were more likely to use crowdfunding than top-tier universities.

In general, donation-based or reward-based crowdfunding are the primary models used in academia. These models align with the nature of research funding, which cannot typically offer financial returns. There are emerging instances of equity crowdfunding for university spin-off companies, but this remains rare (Troise and Bresciani, 2023).

Universities use crowdfunding for a range of purposes. Most prominently, it serves to support early-stage research, pilot studies, and proof-of-concept projects that are often too small or experimental to attract conventional grants (Verhoeven and Palmer, 2015). Crowdfunding is also increasingly employed to enhance student learning experiences, fund teaching-related initiatives, and support extracurricular activities, such as sports or creative arts (Madeo, 2021). In some cases, it is used to provide scholarships or subsidize student participation in fieldwork and international programs, especially in underfunded institutions (Horta et al., 2021). One Italian university used crowdfunding to upgrade facilities (Colasanti et al. 2018). For universities, it also functions as a strategic tool to increase visibility, promote institutional branding, and build relationships with alumni and external stakeholders (O'Donnell, 2021).

The amount of funding universities are typically seeking is relatively modest rather than fully fledged commercialization of products. These campaigns, however, can serve as a bridge to later commercialization by providing data or prototypes that help attract traditional grants or investors. Universities that do support crowdfunding tend to position it as a complement to, not replacement for, traditional funding.

3.2 Crowdfunding Platforms Used by Universities

Universities exploring crowdfunding for research commercialization rely on a variety of platforms, ranging from general-purpose to science-specific, and in some cases, institutional in-house solutions. The choice of platform often depends on the type of research, target audience, geographic context, and the level of institutional support available.

One of the earliest academic crowdfunding initiatives was the #SciFund Challenge, which ran from 2011 to 2012 and used a dedicated section of the RocketHub platform. The campaign hosted over 150 researcher-led projects, with funds directed to researchers' home institutions or associated non-profit organizations (Byrnes et al., 2014). RocketHub allowed flexible funding models and enabled researchers to benefit from science communication training alongside their campaign activities.

The most prominent science-specific platform is Experiment.com, which has since become a preferred choice for individual researchers seeking to crowdfund scientific studies. It focuses exclusively on scientific projects and

offers transparency, credibility checks, and structured templates tailored for academic needs. The platform facilitates donation-based crowdfunding, often targeting early-stage or exploratory research that may not yet qualify for traditional grants.

In Australia, the platform Pozible has played a central role in academic crowdfunding. Deakin University partnered with Pozible to launch Research My World, a university-branded campaign inviting the public to support specific research projects (Verhoeven and Palmer, 2015).

Additional niche platforms such as Consano, Crowd.Science, and Techmoola have emerged to support donation-based crowdfunding for health, science, and innovation-oriented projects. These platforms are designed to connect researchers with donor communities passionate about specific causes, such as medical research or technological advancement (Liu et al., 2022).

Equity crowdfunding platforms such as CrowdFundMe, Opstart, Mamacrowd, StartsUp, and BacktoWork24 have been used specifically by university spin-offs in Italy to raise capital. These platforms provide a digital infrastructure for academic entrepreneurs to access a broad investor base and bypass traditional funding channels, and also validate their business models, engage new stakeholders, and enhance the legitimacy of their ventures (Troise et al. 2023).

Finally, some universities have taken a step further by establishing institutional crowdfunding portals, usually focused on student-driven innovation, alumni engagement, or philanthropic donations. These platforms, often hosted under university development offices or foundations, support small-scale projects and pilot studies while reinforcing the university brand and oversight. However, such platforms are still relatively rare and vary greatly in terms of functionality, transparency, and support provided to researchers (Horta et al., 2021).

3.3 Success Factors in Academic Crowdfunding

Across the literature, there is a strong consensus that the success of academic crowdfunding campaigns hinges more on campaign design and outreach than on scientific merit. Key factors include audience engagement, storytelling, credibility signals, campaign pragmatism, and platform choice.

A large pre-existing network via social media, mailing lists, or public outreach has consistently emerged as a predictor of success (Siva, 2014; Verhoeven and Palmer, 2015; Byrnes et al., 2014). In addition, effective communication, particularly a clear, relatable, and emotionally resonant narrative is widely cited as essential. Campaigns that highlight societal relevance and convey researcher enthusiasm tend to resonate with backers, regardless of the topic's inherent "flashiness" (Wheat et al., 2013; Schäfer et al., 2018; Parrick and Chapman, 2020). Visual design, including the use of compelling images and short videos, enhances accessibility and builds emotional connection (Schäfer et al., 2018; Liu et al., 2022).

Maintaining momentum through regular campaign updates is another success driver, signaling credibility and transparency (Liu et al., 2022; Hase et al., 2022). Active engagement during the campaign, including frequent updates, targeted emails, and press outreach, also boosts funding outcomes (Hesselbein, 2023; O'Donnell, 2017). Setting a modest, realistic funding goal, often under $5,000 is linked with higher success rates, especially on all-or-nothing platforms (Sauermann et al., 2019; Byrnes et al., 2014). Campaigns that break down larger projects into fundable components are more likely to be successful.

While many academic campaigns rely on donations, those offering additional creative non-monetary rewards, such as lab tours or written acknowledgments, tend to perform better (Wheat et al., 2013; Schäfer et al., 2018). Besides, endorsements from credible third parties serve as trust signals that positively influence funding outcomes (Liu et al., 2022; Ikkatai et al., 2018).

Attributes of the campaign leader also play a role. Studies show that projects led by early-career researchers and women have higher success rates, possibly reflecting backer preferences for approachability and perceived need (Sauermann et al., 2019; Hesselbein, 2023). Larger teams also benefit from access to broader networks and complementary skills (Lenart-Gansiniec, 2024).

Finally, the choice of platform significantly impacts outcomes. Science-specific platforms like Experiment.com tend to yield higher success rates but smaller funding totals, whereas general platforms like Kickstarter may reach broader audiences with higher targets if campaigns are broadly appealing (Wheat et al., 2013; Ikkatai et al., 2018; Madeo, 2021). Platform mechanics, such as all-or-nothing vs. flexible funding, shape strategy and urgency, underscoring the importance of aligning campaign design with platform norms (O'Donnell, 2020; Alma'amun et al., 2021). The Table 1 below synthesizes the success factors in academic crowdfunding.

Table 1: Success Factors in Academic Crowdfunding

Factor	Examples	Supporting studies
Audience reach and engagement	Social media presence, network size, public engagement, outreach efforts, donor communication, press/media reach	Siva (2014); Verhoeven and Palmer (2015); Hui and Gerber (2015); Wheat et al. (2013); Byrnes et al. (2014); Hesselbein (2023); O'Donnell (2017); Liu et al. (2022)
Storytelling and content quality	Narrative clarity, emotional storytelling, accessible language, humour, public relevance	Siva (2014); Verhoeven and Palmer (2015); Wheat et al. (2013); Parrick and Chapman (2020); Schäfer et al. (2018); Hase et al. (2022); Troise and Bresciani (2023); Vachelard et al. (2016); Baskerville and Cordery (2014)
Campaign design	Use of visuals (video/images), interactivity, campaign clarity, minimal donor friction, donation mechanics	Verhoeven and Palmer (2015); Liu et al. (2022); Schäfer et al. (2018); Vachelard et al. (2016); Madeo (2021); O'Donnell (2017)
Trust	Institutional support, endorsements, researcher characteristics, transparency, peer recognition	Lenart-Gansiniec and Chen (2023); Sauermann et al. (2019); Liu et al. (2022); Mruk-Tomczak and Jerzyk (2023); O'Donnell (2021); Hui and Gerber (2015); Ikkatai et al. (2018)
Platform setup	Platform selection (general vs. science-specific), user interface, payment systems, campaign hosting	Ikkatai et al. (2018); Wheat et al. (2013); Madeo (2021); O'Donnell (2020); Alma'amun et al. (2021); Sauermann et al. (2019)
Campaign setup	Realistic funding targets, tailored backer rewards, donation tiers, goal setting, segmentation	Sauermann et al. (2019); Liu et al. (2022); Vachelard et al. (2016); Colasanti et al. (2018); Schäfer et al. (2018)
Community	Alumni connection, stakeholder belonging, peer-to-peer trust, internal community spirit, institutional branding	Fortezza et al. (2023); Colasanti et al. (2018); Son-Turan (2016); Cho et al. (2019); Alma'amun et al. (2021); Baskerville and Cordery (2014)

3.4 Barriers and Challenges

The studies highlight significant barriers that limit the adoption and effectiveness of crowdfunding for academic research and commercialization (see Table 2). A fundamental challenge is simply lack of awareness or acceptance of this funding model within academia. Many researchers either do not know about crowdfunding or do not view it as a viable or appropriate way to fund research (Ekpe et al. 2017).

Many universities lack institutional frameworks or support policies for crowdfunding, making it difficult for researchers to integrate campaigns into official research workflows (O'Donnell, 2020; O'Donnell, 2017). Bureaucracy, and unclear financial processes further complicate administration, often forcing academics to devise ad hoc solutions for collecting and managing funds (Troise et al., 2023; Madeo, 2021). Even when crowdfunding is allowed, researchers frequently report limited institutional training or mentorship in campaign design and outreach, which discourages uptake (O'Donnell, 2021; Ekpe et al., 2017).

Legal and regulatory uncertainty is a recurring concern, particularly around donation processing, tax implications, and intellectual property rights (Paseri, 2019; Lenart-Gansiniec, 2024). Posting project ideas online can constitute public disclosure, jeopardizing patent eligibility and raising compliance issues, especially in universities where crowdfunded funds may be treated as gifts (Verhoeven and Palmer, 2015). Furthermore, the absence of peer review or accountability mechanisms on many platforms contributes to skepticism about scientific integrity (Ikkatai et al., 2018; Siva, 2014). Concerns over fraud or transparency, exacerbated by media reports of failed or dubious campaigns, can deter both institutions and potential backers (Wheat et al., 2013; Liu et al., 2022).

Crowdfunding often faces cultural resistance within academia, where it may be perceived as less legitimate than traditional grant funding. Some academics fear that seeking public support could be seen as "begging" or a sign that their work could not succeed through conventional peer review (Lenart-Gansiniec and Chen, 2023; Hesselbein, 2023). Public engagement remains undervalued in academic career assessments, limiting incentives to invest in crowdfunding, even when it aligns with broader impact goals (Byrnes et al., 2014). This misalignment with traditional research norms contributes to a perception that crowdfunding is a peripheral or "last resort" activity (Schäfer et al., 2018).

Resource demands are another major barrier. Campaigns are highly time- and labor-intensive, often requiring researchers to devote 10-20 hours per week to video production, social media, and backer communication on

top of existing academic responsibilities (Vachelard et al., 2016; Hui and Gerber, 2015). Many lack the necessary skills in science communication, digital marketing, and fundraising to run a successful campaign (Lenart-Gansiniec, 2024; Hase et al., 2022). Moreover, most science campaigns yield small sums, limiting their utility for large-scale research (Wheat et al., 2013). These constraints are particularly burdensome for early-career researchers, who may lack institutional support or peer recognition (Sauermann et al., 2019; Horta et al., 2021).

A final set of barriers pertains to communication and platform challenges. Scientific merit alone does not predict success; instead, campaigns that prioritize entertainment value or emotional appeal tend to perform better, leading to concerns that rigorous or complex research may be overlooked (Schäfer et al., 2018; Siva, 2014). Donor motivations are not always well understood, and backers often come from the researcher's immediate network rather than the general public (Hase et al., 2022; Parrick and Chapman, 2020). Furthermore, platform features may not align with the structure of academic research: general platforms like Kickstarter may require tangible rewards and tight timelines that are poorly suited for long-term or intangible outcomes (Baskerville and Cordery, 2014; Liu et al., 2022).

Table 2: Barriers and Challenges in Academic Crowdfunding Adoption

Barrier	Examples	Supporting Studies
Institutional	Lack of institutional support or policy	Ekpe et al. (2017); Lenart-Gansiniec and Chen (2023); Wheat et al. (2013); Ikkatai et al. (2018); Alma'amun et al. (2021); O'Donnell (2020); Madeo (2021)
	Bureaucracy and fragmentation	O'Donnell (2021); Troise et al. (2023); Mruk-Tomczak and Jerzyk (2023)
	Lack of internal processes/training	O'Donnell (2017); Byrnes et al. (2014); Colasanti et al. (2018)
Legal	Regulatory/legal uncertainty	Paseri (2019); Verhoeven and Palmer (2015); Lenart-Gansiniec and Chen (2023); O'Donnell (2020); Baskerville and Cordery (2014)
	Lack of peer review or accountability	Siva (2014); Ikkatai et al. (2018); Wheat et al. (2013); Schäfer et al. (2018); Lenart-Gansiniec (2024); Sauermann et al. (2019)
	Transparency and fraud concerns	Alma'amun et al. (2021); Liu et al. (2022); O'Donnell (2020)
Cultural	Cultural resistance and stigma	Verhoeven and Palmer (2015); Byrnes et al. (2014); Hesselbein (2023); Lenart-Gansiniec and Chen (2023)
	Academic undervaluation of public engagement	Byrnes et al. (2014); Parrick and Chapman (2020); Schäfer et al. (2018)
	Misalignment with traditional models (e.g., peer review, merit-based funding)	Lenart-Gansiniec and Chen (2023); Ikkatai et al. (2018); Wheat et al. (2013); Baskerville and Cordery (2014)
Resource	Time- and labour-intensive nature	Siva (2014); Verhoeven and Palmer (2015); Wheat et al. (2013); Lenart-Gansiniec (2024); Hesselbein (2023); Byrnes et al. (2014)
	Lack of digital, outreach, or fundraising skills	Ekpe et al. (2017); Mruk-Tomczak and Jerzyk (2023); Parrick and Chapman (2020); O'Donnell (2017); Lenart-Gansiniec (2024)
	Small-scale returns and limited funding scope	O'Donnell (2017); Madeo (2021); Baskerville and Cordery (2014)
	Burden on early-career researchers	Horta et al. (2021); Sauermann et al. (2019); Hesselbein (2023)
Communication	Scientific merit does not predict success	Schäfer et al. (2018); Hase et al. (2022); Sauermann et al. (2019)
	Lack of awareness or donor motivation insight	Cho et al. (2019); Fortezza et al. (n.d.); Son-Turan (2016); Parrick and Chapman (2020)
	Platform mismatch or technical limitations	Ikkatai et al. (2018); Troise et al. (2023); Alma'amun et al. (2021); Verhoeven and Palmer (2015); Mruk-Tomczak and Jerzyk (2023)

3.5 Outcomes and Impact

Several studies report positive outcomes from crowdfunded research projects, albeit on a modest scale. A successful campaign can enable a project that might otherwise not occur due to lack of funding. For example, researchers have used crowdfunding to gather preliminary data that later helped secure larger grants, or to develop prototypes of an invention to attract investors (Siva 2014). In this way, crowdfunding can act as a bridge in the research-to-commercialization pipeline. Some crowdfunded projects have led to tangible outputs such as publications, pilot experimental results, or the launch of small spin-off efforts.

Beyond the dollars raised, a frequently cited benefit is public engagement. Researchers often gain a network of supporters and increased visibility for their work (Hui and Gerber 2015). Donors, in turn, report feeling more connected to the scientific process (Hase et al. 2022). This engagement has intangible impacts: it can enhance science literacy and build trust between universities and the public.

4. Discussion and Conclusion

This scoping review shows that crowdfunding is being used in academic research funding in limited but growing ways. It is not a replacement for traditional funding, but rather a complementary tool best suited for specific purposes, such as seeding early-stage projects, engaging the public, and supporting niche research that might not find support elsewhere. When strategically applied, crowdfunding can integrate into a university's research commercialization ecosystem by providing initial momentum for projects (both in funding and in public interest) that can lead to downstream opportunities.

For universities, a key implication is the need to provide support and guidance if they want to leverage crowdfunding. This includes training researchers in effective science communication and campaign management, establishing clear policies on handling crowdfunded money, and addressing legal and ethical concerns (O'Donnell 2020). In turn, this might encourage more academics to consider crowdfunding as part of their project funding strategy.

At the same time, stakeholders must be mindful of the challenges. Ensuring that quality science is funded requires some oversight, for instance, a light-touch review of proposed crowdfunded projects could help maintain standards and protect the university's reputation. There is also a need to monitor whether crowdfunding introduces any biases or inequities in whose work gets funded and to develop strategies to mitigate this.

Given the evolving nature of crowdfunding, further studies could examine the following topics:

1. Long-term outcomes of crowdfunded projects: do they lead to successful commercialization or career advancement for the researchers?
2. Comparative effectiveness of different crowdfunding models (e.g., donation vs equity) in the academic setting;
3. The perceptions of donors who fund research, what motivates them, and how do they evaluate their impact?
4. How crowdfunding might differ across disciplines, and why?

In conclusion, crowdfunding offers universities and researchers an innovative but challenging avenue for supporting research and commercialization. As the practice matures, with better institutional frameworks and greater understanding among academics, crowdfunding could become a more routine element of the university research funding landscape. The continued documentation and analysis of its uses will be important for guiding policy and practice in this domain.

Ethics Declaration

Ethical clearance was not required for this study, as it involved a scoping review of publicly available literature and did not include personal or organizational data.

AI Declaration

In addition to academic databases, the AI-based tool ResearchRabbit was used to identify supplementary literature and assist with data organization for the extraction sheet. As English is not the author's first language, Grammarly was employed to ensure grammatical accuracy and improve stylistic consistency.

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National Resilience and Smart Specialisation RIS3: Higher Education Institutions as Centres of Excellence in Ireland and the Netherlands

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Abstract: Higher Education Institutions (HEIs) play a pivotal role in driving regional innovation, as evidenced by European funding initiatives such as the EIT HEI Initiative. This paper examines and compares the Regional Innovation Smart Specialisation Strategies (RIS3) of Ireland and the Netherlands, exploring how their divergent approaches affect regional development and resilience. Using a systematic review methodology, the study analyses academic literature, government reports, and EU publications related to RIS3 implementation in both countries. Findings reveal that while the Netherlands employs a decentralised model with strong regional autonomy and governance, Ireland implements a centralised national approach with limited regional specificity, contributing to significant regional polarisation. The Netherlands demonstrates superior performance in circular economy initiatives, deep tech innovation, and sustainable development through its regionally specialised strategies. The paper concludes that Ireland's path to economic resilience requires substantial infrastructure investment and a more regionally tailored approach to smart specialisation, with HEIs serving as crucial catalysts within the Triple Helix model. This research contributes to the theoretical understanding of RIS3 implementation and provides practical implications for policy development in peripheral EU regions.

Keywords: National Resilience, Regional Innovation, Smart Specialisation, Ireland, The Netherlands, Higher Education

1. Introduction

Regional innovation strategies have become increasingly central to European Union economic and cohesion policies, with Smart Specialisation Strategies (RIS3) emerging as a cornerstone for place-based innovation and development. These strategies aim to identify and develop distinctive competitive advantages within regions by aligning research and innovation investments with regional strengths (Foray, 2015). Within this context, Higher Education Institutions (HEIs) are recognised as key drivers of regional innovation ecosystems, contributing to knowledge creation, human capital development, and technology transfer (Trippl et al., 2020). The Triple Helix model, conceptualised by Leydesdorff and Etzkowitz (1996, 1998), offers a framework for understanding the interdependencies between universities, industry, and government in fostering innovation. HEIs occupy a central position in knowledge flows, generating intellectual capital that drives economic development when effectively connected to industry and supported by appropriate governance. As Leydesdorff and Etzkowitz (1998, p.197) note, universities function as "knowledge-intensive locations where different communication flows can be expected to interact with reference to innovative practices." Despite the theoretical coherence of the Triple Helix model and the EU's promotion of Smart Specialisation, RIS3 implementation has varied significantly across member states (Kroll, 2017). This reflects differing governance traditions, institutional landscapes, and territorial challenges. A particularly relevant comparison emerges between Ireland and the Netherlands, two small, open economies with strong innovation ambitions but contrasting approaches to RIS3.

The Irish approach to Smart Specialisation operates within a centralised governance framework, where a single national strategy guides regional innovation activities through three designated NUTS2 regions (Government of Ireland, 2022). In contrast, the Netherlands employs a decentralised model, with four distinct NUTS1 regions developing and implementing differentiated strategies aligned with their specific territorial assets (Van Dam et al., 2021). These divergent approaches raise critical questions about the relationship between governance structures and innovation outcomes, particularly regarding regional balance and systemic resilience. While extensive research has examined various aspects of RIS3 implementation across Europe (Aranguren et al., 2019; Hassink & Gong, 2019; Trippl et al., 2020), comparative analyses between countries with contrasting governance approaches remain limited. Despite their instructive differences, no comprehensive comparative study has directly examined Ireland's and the Netherlands' approaches to Smart Specialisation and their respective outcomes. This constitutes a significant knowledge gap in understanding how governance frameworks aid RIS3 effectiveness in these nations.

This research addresses this gap by conducting a systematic comparative analysis of Ireland and the Netherlands' RIS3, with particular emphasis on HEIs' roles within these contrasting governance frameworks. The study examines three interrelated dimensions: governance structures and implementation mechanisms, Higher Education Institution integration, and infrastructure development patterns. Through this multidimensional

analysis, the research illuminates how divergent governance approaches influence regional innovation outcomes and system resilience.

The research is guided by three principal questions:

1. How do centralised versus decentralised governance approaches influence the implementation and outcomes of RIS3?
2. In what ways do these divergent governance frameworks condition HEIs' capacity to function as regional innovation catalysts?
3. How do infrastructure development patterns interact with innovation governance to enhance or constrain regional resilience?

This comparative analysis holds significant importance for both theoretical understanding and policy development. Theoretically, it contributes to evolving conceptualisations of the Triple Helix model by examining how different governance contexts shape university-industry-government relationships. From a policy perspective, it provides valuable insights for European regions seeking to enhance their innovation strategies, particularly those struggling with regional polarisation and development disparities.

The paper is structured as follows:

- Section 2 reviews the theoretical foundations of Smart Specialisation and the Triple Helix model, examining current literature on RIS3 implementation and HEIs' roles in regional innovation.
- Section 3 outlines the systematic review methodology employed in this comparative analysis.
- Section 4 presents findings on governance structures, HEI integration, and infrastructure development patterns in both countries.
- Section 5 discusses the implications of these findings for theoretical understanding and policy development.
- Section 6 concludes with policy recommendations, acknowledged limitations, and future research directions.

2. Literature Review

This section reviews key academic debates and evidence about Smart Specialisation and the role of Higher Education Institutions (HEIs) in regional innovation. It is structured around four themes: the theoretical basis of Smart Specialisation; governance models for RIS3; HEIs as innovation players; and the role of infrastructure in shaping innovation outcomes.

2.1 Theoretical Foundations: Smart Specialisation and the Triple Helix

Smart Specialisation was introduced by Foray and Van Ark (2007) and later developed by Foray et al. (2009) to address Europe's "innovation paradox." It subsequently evolved into a policy framework for guiding regional development through targeted investment in regional strengths (Foray, 2009, 2015). However, its implementation has proven complex, particularly in balancing centralised strategic direction with local entrepreneurial discovery (McCann & Ortega-Argilés, 2015; Hassink & Gong, 2019). The Triple Helix model (Leydesdorff & Etzkowitz, 1996, 1998) offers a complementary framework by emphasising the dynamic interactions between universities, industries, and governments. While influential, it has been critiqued for assuming balanced roles among actors and for insufficiently addressing institutional and regional imbalances (Cai & Etzkowitz, 2020; Cooke, 2019). Later models such as the Quadruple and Quintuple Helix include civil society and the environment (Carayannis et al., 2014, 2018), but these remain mostly theoretical and rarely tested in real-world cases.

Governance of RIS3 varies widely. Some countries, like Ireland and Poland, use a centralised system, while others, such as the Netherlands and Germany, are more decentralised (Kroll, 2017; Trippl et al., 2020). Centralised systems often overlook local needs (Healey, 2018), whereas decentralised systems tend to match strategies with local strengths but can suffer from fragmentation. HEIs are seen as anchors in their regions (Goddard et al., 2016), yet their role is influenced by national policies and incentives (Brown, 2016). In Ireland, the Irish Universities Association plays a key role in shaping national research, development, and innovation (RDI) policy by engaging with the government, while in the Netherlands, universities tend to have stronger formal ties with regional governments and industries, fostering closer regional innovation collaboration (Benneworth & Pablolet, 2021).Infrastructure also shapes innovation by supporting knowledge flow and

collaboration (Rodríguez-Pose & Di Cataldo, 2015). This research addresses gaps in comparing these factors between Ireland and the Netherlands.

2.2 Governance Approaches to RIS3 Implementation

There is a wide range of governance models for RIS3, reflecting national traditions and structures. Kroll (2017) outlines a spectrum from highly centralised to decentralised models. Each comes with pros and cons. Trippl et al. (2020) found decentralised approaches allow better local involvement but may lack strategic unity. Centralised systems help with coordination but often struggle to reflect local realities. Studies of countries like Ireland, Poland, and Romania show that centralised models tend to favour national goals over regional priorities. Healey (2018) argues these systems often fail to deliver place-based innovation, especially where regional autonomy is weak. In contrast, decentralised systems such as in the Netherlands, Denmark, and Germany seem more responsive to local needs. Asheim et al. (2017) highlight the need for cross-region coordination to avoid fragmentation. This reflects Foray's (2015) call for place-based innovation that avoids fragmentation.

2.3 Higher Education Institutions in Regional Innovation Ecosystems

Universities are now seen as key players in regional innovation, beyond just transferring technology. Goddard et al. (2016) outline how HEIs contribute through research, education, and civic engagement. Yet their effectiveness varies. Vallance et al. (2017) show that both internal structures and external conditions shape how HEIs engage in innovation, with major differences between leading and lagging regions. Kempton (2019) notes that universities often face a clash between international research priorities and local roles. This tension is made worse by national performance metrics that don't always reward regional activity (Brown, 2016). Benneworth and Pablolet (2021) studied how universities take part in entrepreneurial discovery across Europe. They found good results when universities are formally linked to regional innovation plans something often missing in centralised systems. Dutch HEIs are better integrated. In regions like the Northern Netherlands, formal partnerships help universities support regional specialisation (Benneworth & Pablolet, 2021). Still, few studies directly compare how national governance affects university roles a gap this study will help to address.

2.4 Infrastructure Development and Regional Innovation Capacity

Infrastructure is increasingly seen as vital to regional innovation. Rodríguez-Pose and Di Cataldo (2015) found strong links between infrastructure and innovation results across Europe, especially for spreading knowledge and turning it into products. Crescenzi and Rodríguez-Pose (2020) show digital infrastructure is especially important in remote regions. Balland et al. (2019) add that transport networks affect how often businesses and universities work together. Still, it remains challenging to prove direct cause-and-effect, and other factors like education and local institutions matter too (Iammarino et al., 2018). In Ireland, infrastructure gaps hold back less-developed areas. The Netherlands shows a more even spread. Moghadam-Saman et al,. (2020) highlight the role of green infrastructure in supporting competitiveness. This research adds to the literature by comparing how different governance models shape the link between infrastructure and innovation.

2.5 Synthesis and Research Gaps

This review points to four main gaps in current knowledge:

1. While Smart Specialisation and the Triple Helix are well-developed in theory, there is little empirical work comparing how governance systems affect how these ideas are put into practice.
2. We know HEIs matter for regional innovation, but don't fully understand how national policies help or hinder their involvement.
3. Infrastructure clearly affects innovation, but the role of governance in shaping this link is under-explored.
4. Despite clear differences between Ireland and the Netherlands, no major studies have directly compared their RIS3 strategies.

This research fills these gaps by comparing the two countries across governance models, university engagement, and infrastructure, helping both theory and policy development.

3. Methodology

This section outlines the systematic approach used to analyse and compare Smart Specialisation Strategies (RIS3) in Ireland and the Netherlands. Positioned within an interpretive paradigm, the research recognises the complexity of innovation ecosystems while ensuring rigour through structured data collection and a systematic comparative framework.

3.1 Research Design

A qualitative comparative case study design, based on Yin's (2018) principles, was chosen to explore "how" and "why" questions concerning RIS3 implementation in real policy contexts. This approach suits complex policy phenomena where social and institutional settings are key to understanding processes. Comparing Ireland and the Netherlands, which differ in governance models but share characteristics as small, open European economies, provides a "most similar systems design" (Gerring, 2017) that links RIS3 outcomes primarily to governance differences rather than broader contextual factors. Ireland employs a centralised RIS3 governance, while the Netherlands follows a decentralised, multi-level system. This contrast offers rich insights into how governance affects innovation strategies.

3.2 Data Collection

A structured data collection strategy gathered comprehensive evidence from diverse sources to enable robust triangulation and reduce bias.

- Academic Literature: A broad systematic review was conducted across major databases (Scopus, ScienceDirect, Google Scholar) using terms such as "Smart Specialisation," "RIS3," "Triple Helix," and "Higher Education Institutions AND innovation," focusing on peer-reviewed publications. Over 120 studies were initially screened, with approximately 40 key journal articles selected and cited for detailed thematic analysis.
- Policy Documents: Official policy documents were collected from European Commission portals (DG Regio, DG Research & Innovation), national and regional government websites in both countries, and EU Structural Funds and EIT resources. Approximately 40 policy reports, evaluations, and strategy documents were reviewed, with key documents from Ireland and the Netherlands cited in this study.
- Statistical Data: Quantitative indicators on innovation and infrastructure were sourced from Eurostat, the European Innovation Scoreboard, and national statistical offices. These data supported empirical triangulation and comparison of innovation capacity and infrastructure at NUTS2 regional levels.

3.3 Analytical Framework

The analysis was guided by a three-dimensional framework informed by qualitative methods (Miles, Huberman, & Saldaña, 2014), focusing on:

- Governance Structures: Examining policy formulation, stakeholder engagement, decision-making, and coordination between national and regional actors. Key questions included how RIS3 priorities are set, the authority of regional bodies, stakeholder integration, and implementation mechanisms.
- HEI Integration: Investigating Higher Education Institutions' roles within RIS3 governance, including collaboration with industry, knowledge transfer, commercialisation, and alignment with regional priorities. Questions addressed how universities connect formally and informally with RIS3 governance, incentives, and boundary-spanning structures.
- Infrastructure Patterns: Analysing the spatial distribution and quality of physical, digital, and environmental infrastructure relative to RIS3 priorities. Key considerations involved digital infrastructure coverage, support for sustainable innovation, and disparities between core and peripheral regions affecting resilience.

3.4 Analytical Process

The analysis followed an iterative abductive reasoning logic:

1. Document Review: All documents were reviewed against the framework's three dimensions.
2. Within-Case Analysis: Each country's data were analysed to identify governance, HEI, and infrastructure characteristics and their interrelations.
3. Cross-Case Comparison: Comparative analysis identified similarities, differences, and causal links, focusing on governance influence over HEI engagement and infrastructure.
4. Theoretical Synthesis: Empirical results were compared with existing theory on RIS3 implementation.

3.5 Validation

To ensure rigour:

- Data Triangulation: Combined academic, policy, and statistical sources to corroborate findings.
- Chronological Analysis: Distinguished early policy aims from later implementation realities.
- Cross-Referencing: Compared academic and policy evaluations for consistency.
- Alternative Explanations: Explored other causal factors beyond governance to avoid bias.

3.6 Limitations

- Dependence on published documents limits insight into informal dynamics and tacit knowledge.
- Government evaluations may exhibit reporting bias favouring positive outcomes.
- Institutional differences and reporting standards challenge full comparability.
- The snapshot covers a transitional policy phase, which may evolve.

These limitations were mitigated through rigorous source selection, triangulation, and transparency, enabling balanced interpretation.

4. Results

This section presents a comparative analysis of Smart Specialisation Strategy (RIS3) implementation in Ireland and the Netherlands, focusing on governance structures, higher education institution (HEI) integration, and infrastructure. The findings reveal significant differences with implications for regional innovation.

4.1 Governance Structures and Policy Frameworks

Ireland uses a centralised RIS3 governance model, with the national government leading strategy and regional assemblies implementing decisions. The three NUTS2 regions lack real policy-making power, leading to similar strategies across regions despite different economic profiles. Stakeholder engagement is limited, and regional innovation performance is uneven. Eastern and Midland outperform while the Northern and Western region lags. The Netherlands employs a decentralised model, where four NUTS1 regions independently develop RIS3 strategies. Regional development agencies and thematic clusters lead strategy creation, supported by broad stakeholder input. For instance, in the Eastern Netherlands, over 80 individuals representing key east Netherlands organisations contributed to the RIS3 process (Technopolis, 2020). Each region has unique strengths, e.g., circular economy in the North, high-tech in the South. Innovation outcomes are more balanced across regions.

4.2 Higher Education Institution Integration

Ireland acknowledges HEIs as innovation anchors, but implementation lags. Initiatives like the TU RISE programme aim to boost regional engagement, yet technology transfer remains below EU averages. In contrast, Dutch HEIs are deeply embedded in regional ecosystems. Universities of applied sciences serve as innovation bridges, with campuses like Water Campus Leeuwarden and High Tech Campus Eindhoven aligning academic work with regional priorities. National and regional funding, such as through the Top Sectors policy, supports this alignment.

4.3 Infrastructure and Regional Innovation

Ireland faces significant infrastructure gaps. Fixed broadband access is uneven, 78% in the Northern and Western region versus 90% in Dublin (CSO, 2024). Storm Éowyn exposed resilience issues: it took two weeks to restore services in the West, compared to 48 hours in Dublin. Green transition infrastructure also falls short; Ireland is set to meet only 29% of its emissions targets (EPA, 2024). The Netherlands shows more balanced infrastructure development. Broadband exceeds 90% nationally, and regions integrate infrastructure with RIS3 goals, for example, the hydrogen valley in the North. Spatial planning at the provincial level ensures alignment with regional innovation needs. The Netherlands leads Europe in circular material use (30.9%) compared to Ireland (1.8%) as seen in the table below.

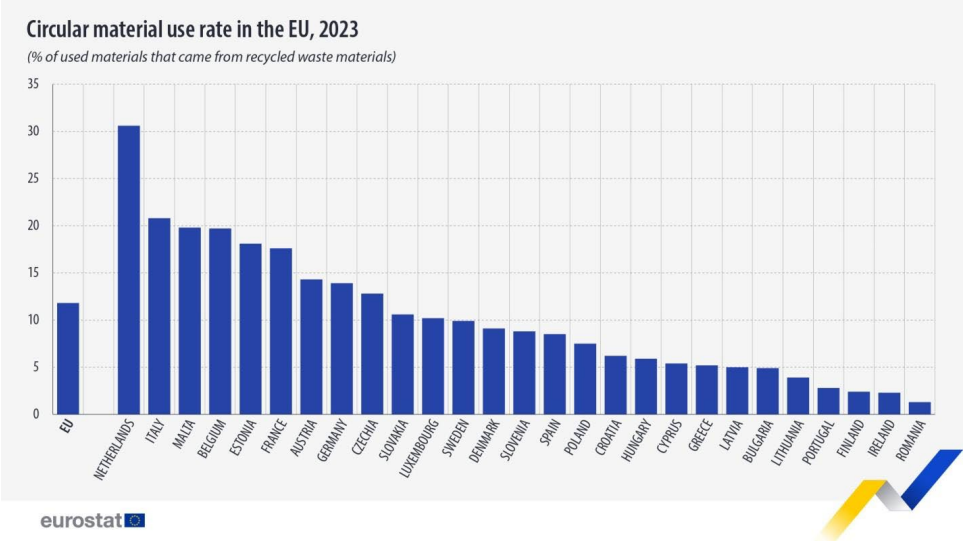


Figure 1: EU Circular material use (Eurostat, 2023)

4.4 Summary of Findings

Ireland's centralised RIS3 model limits regional differentiation and HEI involvement, with uneven infrastructure compounding disparities. The Netherlands' decentralised approach enables place-based specialisation, robust HEI integration, and equitable infrastructure investment. Effective RIS3 implementation requires regional autonomy, engaged HEIs, and balanced infrastructure to foster resilient innovation ecosystems.

5. Discussion of Results

This section discusses comparative findings on Smart Specialisation (S3) implementation and the role of Higher Education Institutions (HEIs) in regional innovation in Ireland and the Netherlands. It highlights how governance structures shape outcomes, offering implications for theory and policy.

5.1 Governance and RIS3 Effectiveness

Ireland and the Netherlands illustrate how governance affects RIS3. The Netherlands' decentralised approach supports regional specialisations tailored to strengths, aligning with Kroll's (2017) and Foray's (2015) arguments on the importance of place-based governance. Ireland's centralised model results in limited regional differentiation, hindering local innovation. However, decentralisation alone does not ensure success. The Netherlands benefits from specific institutional mechanisms that foster stakeholder coordination and knowledge flows, confirming Aranguren et al.'s (2019) view that governance quality matters. Dutch "public–private innovation escalators" (Van Dam et al., 2021) exemplify this. The Triple Helix model is more effectively realised in the Netherlands, where university-industry-government collaboration thrives. In Ireland, fragile regional governance limits Triple Helix implementation, supporting critiques by Cooke (2019) on the model's practical constraints. While economic structure differences (FDI vs. balanced industry) may play a role, the evidence suggests governance frameworks help shape these patterns, aligning with Iammarino et al. (2018).

5.2 HEIs and Regional Innovation

HEIs' regional roles reflect governance structures. Dutch institutions are enabled by established policies and incentives. In contrast, Irish HEIs face performance metrics misaligned with regional engagement, echoing Kempton's (2019) concerns. Universities like Twente demonstrate how tailored governance can balance global and regional missions, countering Brown's (2016) scepticism. Differentiated university roles in the Netherlands complement regional specialisations; Ireland's uniform approach limits responsiveness. Though cultural factors, such as the strong industrial ties of Dutch universities of applied sciences, contribute significantly, policy frameworks remain a key driver of HEI engagement differences. Irish HEIs outside Dublin show minimal involvement due to structural constraints.

5.3 Infrastructure and Innovation

Infrastructure investment reveals another governance difference. The Netherlands ensures balanced digital and physical infrastructure aligned with regional needs, enhancing knowledge flows and innovation capacity (Crescenzi & Rodríguez-Pose, 2020). Ireland is investing €396 million in funding for regional projects under the national RIS3 policy (O'Driscoll, 2025). However concentrated investment limits peripheral regions. Storm Éowyn highlighted infrastructure's role in resilience. The Netherlands planning supports equitable access, reinforcing Balland et al.'s (2019) view on policy agency. The table below, provides an overview of current Irish and Dutch RIS3.

Region / Country	Key Focus Areas	Governance Structure	Key Institutions & Actors	Notable Strengths
Northern Netherlands	Circular economy, energy transition, sustainable agriculture	Strong regional governance via Samenwerkingsverband Noord-Nederland (SNN)	University of Groningen, Universities of Applied Sciences, NOM	Leading in sustainable innovation, EU funding, low-carbon development
Eastern Netherlands	Deep tech (AI, robotics, photonics), precision agriculture	Provincial governance in Gelderland and Overijssel	University of Twente, Fraunhofer Project Centre	Strong applied science base, collaboration in advanced materials
Southern Netherlands	High-Tech Systems & Materials (HTSM), life sciences, biobased economy	Regional innovation clusters, flexible RIS3 implementation	Brainport Eindhoven, ASML, Philips, VDL, regional government	International competitiveness, strong industrial-university collaboration
Western Netherlands	Smart cities, circular economy, smart mobility, creative industries	Metropolitan governance, cross-border cooperation	AMS Institute, TU Delft, Rotterdam's Port	Urban innovation, circular economy projects, diversity and scale
Ireland	Green technology, sustainable solutions, agri-tech	Centralised governance with regional steering groups	Government of Ireland, Enterprise Ireland, Regional Development Agencies	Focus on green tech, EU funding opportunities, potential for growth
Reference	Sources: Van Dam et al. (2018), Benneworth & Pabollet (2021), Interreg Europe (2024), European Commission (2025), OECD (2024)	Table created by author using Excel		

Figure 2: Overview table of S3 in Ireland and the Netherlands created by the author.

5.4 Implications for S3 Theory and Practice

Governance is a critical enabler of S3. The Netherlands demonstrates that effective implementation depends on multi-level coordination, not just decentralisation. Infrastructure is also key but often overlooked in theory. For centralised systems like Ireland's, symbolic regional recognition is insufficient. Real authority and tailored strategies are needed. Operationalising the Triple Helix requires tangible institutions like the Netherlands' innovation escalators.

5.5 Limitations

Findings may not generalise beyond the two countries or account for transition phases between EU programmes. While economic and cultural differences exist, governance emerges as a primary driver of observed patterns. Despite limitations, the consistency across governance, HEI roles, and infrastructure suggests strong links deserving further study.

6. Conclusion

This study compared Smart Specialisation (S3) implementation in Ireland and the Netherlands, focusing on how governance shapes regional innovation and resilience. While both countries formally adopted RIS3 strategies, management approaches significantly influence outcomes related to regional development, university engagement, and infrastructure.

6.1 Synthesis of Key Findings

Three main points emerged.

First, governance strongly impacts RIS3 effectiveness. The Netherlands employs a decentralised system where regions independently design innovation strategies with strong local involvement, fostering unique regional

strengths such as circular economy in the North and deep tech in the East. Ireland's more centralised system features national-level strategy decisions, with local agencies mainly executing plans rather than shaping them.

Second, universities play distinct roles. Dutch HEIs are deeply embedded in regional innovation, supported by policies and evaluation frameworks valuing local impact. Irish universities are developing regional ties but face constraints from performance metrics and funding prioritising academic research over local benefits.

Third, infrastructure influences innovation capacity. The Netherlands has a balanced infrastructure spread supporting innovation across regions, while Ireland shows notable gaps, especially in digital access and environmental infrastructure. For instance, during Storm Éowyn, electricity restoration took two weeks in parts of the Northern and Western region versus 48 hours in Dublin.

6.2 Theoretical Implications

Findings support the premise that successful university-industry-government cooperation depends on clear governance structures rather than symbolic recognition alone. The Dutch model exemplifies effective multi-level coordination and regional ownership, while Ireland illustrates risks when regions lack real authority. Furthermore, infrastructure emerges as a foundational element underpinning both innovation and system resilience.

6.3 Policy Implications

Centralised systems like Ireland's should devolve greater authority and funding to regional bodies, empower them to set context-specific priorities, foster university-regional collaboration, and address infrastructure gaps. For EU policymakers, this study highlights that robust local governance capacity is as critical as financial resources. All Universities need clear mandates for regional engagement, dedicated teams connecting with regional partners, and reward structures valuing local impact.

6.4 Limitations

This research relied on published documents, which may reflect official perspectives and overlook informal practices. The snapshot approach may miss longer-term dynamics. Comparing only two governance models simplifies the broader spectrum found in Europe. These factors limit the direct generalisability of findings.

6.5 Future Research Directions

Future studies should combine document analysis with qualitative interviews involving policymakers, university leaders, and industry representatives to capture practical dynamics. Examining more countries will test governance impacts across contexts. Employing network mapping and long-term evaluations can deepen insights, while studying responses to recent crises would reveal governance's role in regional resilience.

Ethics Declaration

This paper contains publicly available knowledge. Future research will include expert insight from Triple Helix actors, RIS3 bodies and EU lobby groups.

AI Declaration

All ideas and concepts presented are original from the author or include citation. AI tools, including ChatGPT and Grammarly, were used for support with formatting, spelling and grammar, repetition and reducing word count. ChatGPT was consulted for questions, such the origins of the Triple Helix model by Leydesdorff and Etzkowitz and in locating relevant sources. The author exercised discretion in applying suggestions, often choosing to retain original phrasing to preserve their individual writing style. All references were organised using Zotero. The final paper was reviewed and refined by the author. Any AI-suggested references were independently verified, and additional sources were obtained through academic databases.

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Innovation and Green Performance of Female-owned Firms in Emerging Economies: The Mediating Role of top Managements Team Meeting´s Intensity

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Abstract: The green performance of firms and their ability to innovate are crucial for competitiveness in Central and Eastern Europe (CEE), where companies face increasing environmental demands from stakeholders. Despite growing interest in sustainable business practices, female-owned firms – and mostly their innovativeness and green performance – remain underexplored, even though they tend to be more engaged in environmental issues. Moreover, CEE enterprises face challenges related to access to financing, decision-making, and strategic management, affecting their ability to integrate innovation with environmental goals. Against these lines of argument, this study aims to explore how the intensity of top management team meetings with (i) suppliers, and with (ii) employees involved in production activities influences the relationship between R&D investments, innovation, and firms' environmental performance. Our findings show that frequent top management team meetings positively influence firms' ability to transform R&D into innovations, leading to improved environmental performance by providing a structured platform for aligning strategic decisions, optimizing resources, and enhancing internal coordination. In contrast, top management team meetings with suppliers do not consistently foster innovation, particularly in female-owned firms. These differences suggest that while top management team meetings strengthen the link between R&D and sustainability, top management team meetings with suppliers may require restructuring to support ecological transformation more effectively. This study highlights the role of managerial decision-making and structured meetings in linking R&D with green performance and provides insights into how firms in emerging economies can optimize internal and external managerial interactions to enhance sustainability outcomes.

Keywords: Green Performance; Innovation; Female-owned firms; Top Management Meetings; Emerging Economies

1. Introduction

In the contemporary business environment, green performance is a key factor for long-term competitiveness, particularly in Central and Eastern Europe (CEE), where businesses face growing regulatory and environmental pressures (Hojnik et al., 2022; Ahmadov et al., 2024; Prokop et al., 2025). Integrating sustainability into corporate strategy ensures compliance while enhancing efficiency, resilience, and brand reputation (Porter & Van der Linde, 1995; Alam et al., 2019). This challenge is pronounced in emerging economies, where resource constraints and weaker institutional frameworks complicate balancing economic growth with environmental responsibility (Tetrevova at al., 2025). As stakeholders increasingly demand sustainable practices, firms must adapt their strategies to remain competitive (Alam et al., 2019; Ahmadov et al., 2024). While innovation is crucial for green performance, its success depends not only on technology but also on leadership structures and decision-making (Zuraik & Kelly, 2018). Despite top management's recognized role in corporate sustainability (Shipilov & Danis, 2006), limited research explores how managerial leadership drives this transition—particularly in female-owned firms, where strategic priorities may differ (Boone et al., 2019; Machado et al., 2025).

Top management significantly shapes corporate innovation strategies and their alignment with sustainability goals (Zuraik & Kelly, 2018). The Upper Echelons Theory suggests that executive decisions influence environmental performance (Shipilov & Danis, 2006). However, strategic decisions emerge from interactions within leadership teams and external stakeholders. A key mechanism in advancing sustainability is regular management meetings, facilitating discussions on environmental strategies, corporate priorities, and collaboration (Zheng et al., 2019). Despite their importance, the role of these meetings in shaping green performance remains underexplored, leaving a gap in understanding how managerial interactions drive sustainability outcomes. Top management team meetings serve as platforms for decision-making, knowledge exchange, and coordination of innovation activities (Amonarriz et al., 2019). While research so far extensively examines leadership's role in sustainability, the influence of these meetings on green innovation adoption is less understood. Studies suggest that supplier meetings enable knowledge transfer for ecological innovation (Chen et al., 2016), while internal meetings help operationalize these innovations (Singh et al., 2021). However, their effectiveness varies based on focus, structure, and frequency, making this an area for further research.

Gender and innovation have gained attention in management research (Prokop et al., 2023). Gender influences entrepreneurial decision-making (Ryan, 2017), shaping strategic priorities in female-owned firms. The gender socialization theory posits that women emphasize sustainability in business decisions (Adams et al., 2011) and adopt more collaborative and innovative management approaches (Adams & Ferreira, 2009). Despite growing interest, research on female-owned firms and innovation remains limited, especially in emerging economies (Berglund et al., 2012). Female entrepreneurs face unique challenges, including restricted financial access, weaker networking, and different strategic time horizons (Klapper & Parker, 2011), which may influence their engagement in innovation and sustainability through managerial structures such as top management meetings.

Building on these arguments, this study examines how managerial interactions within female-owned firms influence environmental performance in the CEE region. Specifically, we investigate how the intensity of top management teams meetings (TMTMs) transforms R&D investments into green innovation outputs. Grounded in Upper Echelons, Gender Socialization, and Open Innovation theories, this research enhances understanding of how structured managerial interactions support sustainability-oriented strategies, offering insights for businesses and policymakers in emerging economies.

2. Literature Review and Research Question

2.1 Increasing Role of Top Management Teams Meetings: Insights From Upper Echelons and Open Innovation Theories

Top executives play a crucial role in setting firms' strategic priorities, which is a core principle of Upper Echelons Theory (Prokop & Hajek, 2023). Managerial experience and values are reflected in corporate decision-making processes, influencing their approach to innovation (Perryman et al., 2016). Effective TMTMs facilitate information sharing, alignment of strategic goals, and coordination of innovation activities (Amonarriz et al., 2019). Studies indicate that systematic and well-structured management meetings support faster innovation adoption and improve decision-making efficiency (Hardwick & Anderson, 2019; Harymawan et al., 2020). However, in the specific context of emerging economies, it is evident that, in addition to internal meetings within firms, external interactions with partners, particularly suppliers, are critical for innovation.

Engagements between top management and external stakeholders, especially suppliers, can facilitate access to new technologies, materials, and expertise (Thompson, 2018). According to Open Innovation Theory, firms that actively collaborate with external partners have a higher likelihood of successfully implementing sustainable innovations, as they can more efficiently integrate external technological knowledge (Nieto & Santamaría, 2007). However, the effectiveness of these meetings depends on firms' ability to internalize new knowledge and transform it into actionable strategies (Singh et al., 2021). The innovation and green performance of female-owned firms in emerging economies has gained growing attention in recent years, as businesses face mounting environmental and regulatory challenges (Dohse et al., 2019). Although innovation plays a key role in enhancing firms' environmental outcomes, existing research has paid little attention to the specific challenges faced by female entrepreneurs (Boone et al., 2019). The business environment in emerging economies differs significantly from that of developed markets, influencing women's access to innovation, technology, and financing (Foo et al., 2020). Institutional factors can limit opportunities for female entrepreneurs to develop innovative and sustainable businesses, necessitating the adoption of specific managerial strategies to successfully adapt to changing market conditions (Machado et al., 2025).

For female-owned firms, informal networks and management mechanisms can serve as key tools for mobilizing resources needed for innovation implementation. In environments with underdeveloped institutional infrastructure, personal relationships and social capital play a crucial role in ensuring access to technology and financing for green innovations (Bruton et al., 2008). A crucial component in this process is the role of TMTMs and interactions with suppliers (TMMSs), which can facilitate the integration of research, development, and environmental innovations (Prokop & Hajek, 2023).

2.2 Linking Gender and Innovation in Female Entrepreneurship From the Perspective of Gender Socialization Theory

Research suggests that women in top managerial positions approach innovation and environmental strategies differently from their male counterparts (Dohse et al., 2019). Gender Socialization Theory emphasizes that women are more likely to prioritize collaboration, long-term sustainability, and social responsibility (Ryan, 2017). From this perspective, TMTMs in female-owned firms can serve as a crucial platform for fostering innovation, as

they provide a space for strategic decision-making and effective resource management. Additionally, there is increasing discussion about how female entrepreneurs actively contribute to improving the institutional environment, which can further support the implementation of green innovations (Foo et al., 2020). Despite the growing body of research on gender diversity in business, many unanswered questions remain regarding the impact of top management meetings on innovation in female-led firms (Berglund et al., 2012). Studies indicate that these firms often face greater challenges in accessing financing and technological resources, which may hinder their ability to implement innovations (Machado et al., 2025). Therefore, strategic partnerships with suppliers and external stakeholders can serve as a key mechanism for enhancing the innovation capacity of these firms (Jain & Zaman, 2020).

2.3 Conceptual Framework and Research Question

Based on theoretical insights, a conceptual framework has been developed in this research to explore the connection between research and development (R&D), innovation (INNO), and the green performance of firms (GREENPER) in female-owned firms in emerging economies. The framework highlights the mediating role of TMTMs and TMMSs in transforming R&D investments into sustainable and innovative business outcomes. This model is based on several key theoretical approaches. Upper Echelons Theory emphasizes that top management's decision-making and experience significantly influence corporate strategy, which in turn affects both environmental and innovation outcomes (Zheng et al., 2019). Open Innovation Theory focuses on the importance of external collaboration, enabling firms to more effectively integrate new technologies and expertise into their innovation strategies (Prokop & Hajek, 2023). Additionally, Gender Socialization Theory explains that women in leadership positions tend to emphasize collaboration, long-term sustainability, and social responsibility, shaping their approach to innovation and how they utilize top management meetings to support environmental strategies (Ryan, 2017). In female-owned firms, where access to formal financial resources may be limited, building relationships with external stakeholders plays a crucial role in overcoming institutional and market barriers (Bruton et al., 2008). The integration of these theories ensures that R&D investments translate into effective innovations, ultimately enhancing firms' green performance. This framework provides a theoretical foundation for analyzing how managerial interactions, gender socialization, and social capital influence innovation and sustainability strategies in female-owned firms in emerging economies.

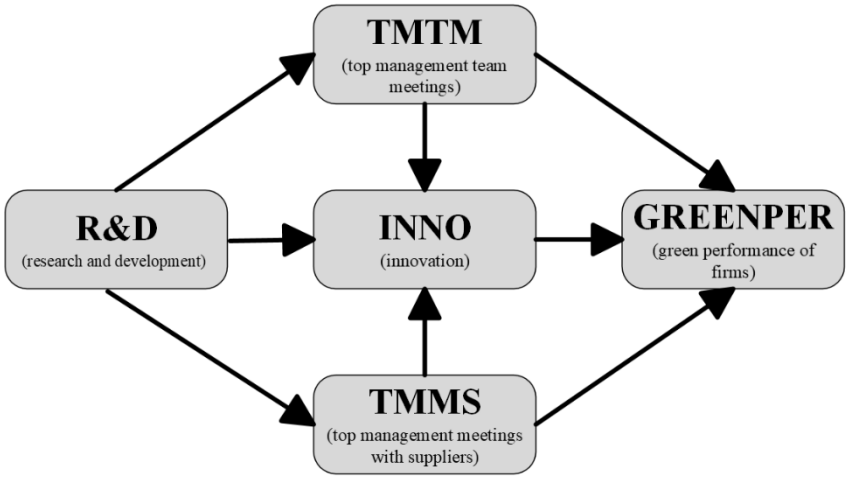


Figure 1: Conceptual framework

Source: own elaboration

Given the crucial role of top management in shaping corporate strategies and fostering external collaborations, it becomes essential to examine how different types of managerial interactions contribute to environmental performance. Based on these theoretical insights, a key research question arises: *How do internal top management team meetings (TMTMs) and meetings with suppliers (TMMSs) differentially impact firms' environmental performance?*

3. Research Methodology

3.1 Data

We utilized data from 191 firms operating in eight Central and Eastern European (CEE) countries, specifically Estonia (14), Lithuania (13), Latvia (16), the Czech Republic (17), Poland (61), Slovakia (20), Bulgaria (43), and Slovenia (6). This sample enabled us to analyze the relationships between top management, innovation, and firms' environmental performance within diverse economic and regulatory contexts across the region. The dataset is based on the World Bank Enterprise Survey (WBES) 2019, which uses a standardized methodology and stratified random sampling to collect firm-level data from top managers or business owners of companies with five or more employees. The sample includes firms from both the manufacturing and service sectors and varies in terms of firm age and size. As this is a preliminary study primarily aiming to provide an initial overview of the selected region, and due to data limitations regarding firms' responses on meeting intensity, the firms are analyzed as a single group representing the Central and Eastern European region.

We selected five constructs: R&D, innovation (INNO), green performance (GREENPER), top management team meetings (TMTMs), and top management team meetings with suppliers (TMMSs). Based on the intensity of these meetings, we divided firms into two groups: those that meet frequently (between 2 and 4 times a week, daily, or more than once a day) and those that either never meet, meet only once a week, or hold meetings spontaneously. The variables examined in this study, along with their corresponding items and abbreviations, are presented in Table 1.

Table 1: Constructs used in the model

Top Management Meetings With Suppliers (TMMS)	TMMS
"In a typical week, how often does the top manager meet with suppliers?"	TMMS
Top Management Team Meetings (TMTM)	TMTM
"In a typical week, how often does the top manager meet with employees involved in production activities?"	TMTM1
"In a typical week, how often does the top manager meet with one or more of the following: Chief Administrative Officer, Chief Marketing Officer, Chief Operating Officer, Business Unit managers, Board members, or managers from a parent company?"	TMTM2
Green Performance	GREENPER
"Over the last 3 years, did this establishment adopt any of the following measures?"	
"Heating and cooling improvements"	GREENPER1
"Energy management"	GREENPER2
"Water management"	GREENPER3
"Improvements to lighting systems"	GREENPER4
Research and Development	R&D
"Over the last 3 years, did this establishment spend money on the acquisition of external knowledge? This includes the purchase or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other businesses or organizations?"	R&D1
"Over the last 3 years, did this establishment spend money on research and development activities within the establishment?"	R&D2
"Over the last 3 years, did this establishment spend money on research and development activities contracted with other companies?"	R&D3
Innovation	INNO
"During the last three years, has this establishment introduced new or improved products or services?"	INNO1
"During the last three years, has this establishment introduced any new or improved process?"	INNO2

Source: WBES 2019

3.2 Methods

In line with the approach used in similar studies (Hair et al., 2019; Nitzl et al., 2016; Hajek & Prokop, 2023), the PLS-SEM (Partial Least Squares Structural Equation Modeling) method was selected for this research. This method effectively analyzes relationships between latent variables in situations where data distribution is less strict, and constructs contain a smaller number of items. PLS-SEM is extensively applied in management and social sciences due to its ability to estimate complex models with multiple relationships while providing high statistical power, even in cases where the sample size is not extremely large (Hair et al., 2019). Additionally, it is suitable for exploratory analyses, where the goal is not only to validate theoretical relationships but also to identify new connections between constructs (Nitzl et al., 2016).

The first step involved testing the reliability and validity of the construct. Reliability was assessed using composite reliability (rho_c), while construct validity was verified through the average variance extracted (AVE). To confirm discriminant validity, the Fornell-Larcker criterion and the heterotrait-monotrait ratio (HTMT) were applied. **In the next step**, path coefficients were analyzed to determine the strength and direction of relationships between constructs. The statistical significance of these relationships was verified using the bootstrapping method, which allowed for the calculation of reliable confidence intervals for each estimated value. **The third step** involved assessing indirect effects within the model, focusing on mediation analysis between variables. Here, both specific and total indirect effects were evaluated, allowing an examination of the extent to which innovation acts as an intermediary between internal managerial processes and the environmental performance of female-owned firms.

4. Results

4.1 Model Validation

To ensure the validity of the model, factor analyses (Rho_c and AVE) were conducted to measure the reliability and validity of the construct (see **Table *2***). The values exceeded 0.60, which is considered acceptable (Hair et al., 2019). The reliability of the model was confirmed by composite reliability (rho_c > 0.6), and its validity was verified using the average variance extracted (AVE > 0.5). Additionally, outer loadings were examined to assess how strongly individual indicators contribute to explaining the construct. Most values were above the recommended threshold of 0.7, confirming the sufficient convergent validity of the model.

Table 2: Model Reliability and Validity

	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
CONTR	0.702	0.548
GREENPER	0.819	0.532
INNO	0.813	0.686
R&D	0.794	0.563
TMTM	0.820	0.696

Source: Own analysis

To verify discriminant validity, the HTMT (heterotrait-monotrait ratio) was applied. Since one value exceeded the critical threshold of 0.85 (**Table *3***), the Fornell-Larcker method was additionally used (**Table *4***). This approach compares the square root of the average variance extracted (AVE) for each construct with inter-construct correlations. The results indicated that the square root of AVE was higher than all inter-construct correlations, confirming the sufficient discriminant validity of the model.

Table 3: Discriminant validity – heterotrait-monotrait (HTMT)

	CONTR	GREENPER	INNO	R&D	TMMS	TMTM
CONTR						
GREENPER	0.961					
INNO	0.435	0.549				

	CONTR	GREENPER	INNO	R&D	TMMS	TMTM
R&D	0.849	0.507	0.684			
TMMS	0.014	0.087	0.064	0.173		
TMTM	0.306	0.216	0.490	0.200	0.261	

Source: Own analysis

Table 4: Fornell-Larcker criterion

	CONTR	GREENPER	INNO	R&D	TMMS	TMTM
CONTR	**0.740**					
GREENPER	0.367	**0.729**				
INNO	0.163	0.358	**0.828**			
R&D	0.306	0.337	0.396	**0.750**		
TMMS	0.002	-0.065	0.055	-0.081	**1.000**	
TMTM	0.011	0.138	0.286	0.112	0.202	**0.834**

Source: Own analysis

Based on these results, the model can be considered suitable for analyzing and interpreting relationships between variables, meeting the requirements for reliability, validity, and discriminant validity.

4.2 Direct and Indirect Effects

The results of the path coefficient analysis revealed several statistically significant relationships between constructs (**Table *5***). We show that innovation (INNO) significantly influences firms' environmental performance (GREENPER), supporting the assumption that innovation activities in female-owned firms can positively contribute to their environmental outcomes. A crucial factor in this relationship is also R&D, which demonstrated a strong positive association with innovation. This finding confirms that investment in R&D is a key prerequisite for the implementation of innovations. While TMTMs had a positive and statistically significant effect on innovation, the relationship between TMMSs and innovation was not confirmed. This suggests that internal coordination and decision-making processes at the leadership level have a greater impact on innovation than external collaboration with suppliers.

Table 5: Bootstrapping test on path coefficients

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistic (|O/STDEV|)	P Values
CONTR→ GREENPER	0.369	0.379	0.084	4.410	0.000***
INNO→ GREENPER	0.290	0.296	0.080	3.622	0.000***
R&D→ INNO	0.458	0.467	0.085	5.369	0.000***
R&D→ TMMS	-0.090	-0.088	0.092	0.977	0.328
R&D→ TMTM	0.140	0.151	0.084	1.677	0.094*
TMMS→ GREENPER	-0.106	-0.107	0.073	1.450	0.147
TMMS→ INNO	0.042	0.039	0.078	0.536	0.592
TMTM→ GREENPER	0.068	0.070	0.069	0.994	0.320
TMTM→ INNO	0.231	0.232	0.064	3.632	0.000***

****significant at P < 0.01; **significant at P < 0.05; *significant at P < 0.10.* *Source: Own analysis*

Based on the bootstrapping results, significant total indirect effects were identified, indicating that some relationships between constructs may be mediated by other variables. Therefore, we further analyzed the specific indirect effects to determine which constructs serve as mediating mechanisms. Regarding specific

indirect effects (**Table *6***), we show that R&D enhances environmental performance through innovation. A similar effect was observed in the relationship TMTM → INNO → GREENPER, suggesting that TMTMs support innovation, which in turn improves firms' environmental performance. In contrast, the effect of TMMS on environmental performance through innovation was not statistically significant, indicating that engaging external partners may not be a key factor for driving innovation within analysed female-owned firms in emerging economies.

Table 6: Bootstrapping Test: Specific total Indirect Effects

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistic (|O/STDEV|)	P Values
R&D → TMMS → INNO	-0.004	-0.003	0.010	0.366	0.715
R&D → INNO→GREENPER	0.133	0.139	0.048	2.774	0.006***
TMMS→ INNO→ GREENPER	0.012	0.012	0.024	0.502	0.615
TMTM→ INNO→ GREENPER	0.067	0.069	0.028	2.408	0.016***
R&D→ TMTM→ INNO→ GREENPER	0.009	0.010	0.007	1.368	0.172
R&D→ TMMS→ INNO→ GREENPER	-0.001	-0.001	0.003	0.353	0.724
R&D→ TMTM→ GREENPER	0.010	0.011	0.014	0.698	0.485
R&D→ TMMS→ GREENPER	0.010	0.011	0.014	0.693	0.488
R&D→ TMTM→ INNO	0.032	0.034	0.021	1.545	0.122

****significant at P < 0.01; **significant at P < 0.05; *significant at P < 0.10.* *Source: Own analysis*

The overall effects analysis (**Table *7***) showed that the most significant factors influencing the environmental performance of female-owned firms are innovation and TMTMs. R&D plays a key role as a source of innovations, which subsequently lead to improved environmental outcomes. In contrast, TMMS did not demonstrate a significant effect, which may reflect the fact that innovations are primarily driven by internal managerial decision-making processes rather than external partnerships.

Table 7: Bootstrapping Test: Total Effects

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistic (|O/STDEV|)	P Values
CONTR→ GREENPER	0.369	0.379	0.084	4.410	0.000***
INNO→ GREENPER	0.290	0.296	0.080	3.622	0.000***
R&D→ GREENPER	0.160	0.170	0.050	3.240	0.001***
R&D→ INNO	0.487	0.498	0.089	5.495	0.000***
R&D→ TMMS	-0.090	-0.088	0.092	0.977	0.328
R&D→ TMTM	0.140	0.151	0.084	1.677	0.094*
TMMS→ GREENPER	-0.094	-0.095	0.071	1.312	0.190
TMMS→ INNO	0.042	0.039	0.078	0.536	0.592
TMTM→ GREENPER	0.135	0.139	0.065	2.075	0.038***
TMTM→ INNO	0.231	0.232	0.064	3.632	0.000***

****significant at P < 0.01; **significant at P < 0.05; *significant at P < 0.10.* *Source: Own analysis*

5. Conclusion

Based on the conducted analysis, it can be concluded that analyzed female-owned firms in emerging economies face specific challenges in integrating innovation with environmental goals. Limited access to financing, strategic management, and managerial structures significantly impacts their ability to link R&D with innovations (Prokop et al., 2025; Tetrevova at al., 2025). This study focused on the role of TMTMs and TMMSs in shaping firms'

environmental efficiency and their ability to innovate in line with sustainability principles. The findings suggest that TMTMs are instrumental in shaping how firms convert R&D investments into innovations. These meetings provide a platform for structured discussions, strategic alignment, and more efficient resource allocation toward sustainability goals. Firms that regularly hold internal meetings achieve better environmental performance outcomes, as they can systematically plan ecological innovations and improve coordination in strategic decision-making (Zuraik & Kelly, 2018; Zheng et al., 2019). Conversely, companies that do not organize these internal meetings face greater challenges in implementing sustainability strategies, slowing down their ecological transformation (Valencia Arias et al., 2024).

In contrast to internal meetings, TMMSs do not consistently demonstrate a positive impact on firms' environmental performance. This may be because such meetings often focus primarily on operational issues and short-term goals, rather than being utilized for strategic planning of environmental innovations (Prokop & Hajek, 2023). Although suppliers can play an important role in enhancing the environmental performance of firms – such as through the adoption of sustainable materials, emission reduction, or supply chain optimization— companies often fail to leverage these meetings for discussing long-term environmental objectives. For supplier meetings to be more effective, it is essential to restructure them, incorporate strategic ecological topics, and promote more intensive collaboration in sustainability efforts.

These findings have significant practical implications, particularly in the CEE region. Encouraging structured managerial interactions can accelerate the transition to improved environmental performance and enhance the competitiveness of female-owned businesses (Foo et al., 2020; Machado et al., 2025). However, our findings are also limited by the sample size, as collecting corporate data on stakeholder engagement remains an emerging research field. Future research should focus more closely on analyzing the impact of external partnerships on the environmental performance of female-owned firms. It is important to examine how interactions with external suppliers can be more effectively utilized to support environmental strategies. The present study does not distinguish between different types of innovation and does not include a comparison with male-owned firms, as it deliberately focused on coordination mechanisms in female-owned businesses. Both aspects represent limitations of research design but also offer directions for future studies.

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Ethics Declaration

Ethical approval was not required for this study.

AI Declaration

AI was not used in this article.

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Traits of Innovative Leadership

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Abstract: Innovations are essential in maintaining or obtaining a competitive advantage. Innovations emerge from the combination of new resources and creative efforts, providing a significant foundation for economic growth. By promoting a culture of innovation, an organization's ability to innovate is strengthened. Innovative companies are better positioned to utilize the full potential of external knowledge and resources to enhance their innovation activities and, in turn, gain competitive advantages. The culture of an organization is directly affected by the leadership of an organization. Leadership can promote a culture valuing creativity and risk taking while also encouraging employees to seek innovative ideas. Innovative leadership is also characterized by the ability to inspire and motivate teams to embrace change. Innovative leadership involves setting a clear vision, fostering a culture of continuous learning, and encouraging collaboration across all levels of the organization. Organizations are faced with rapidly changing environments and smart technologies. Innovative leaders are adaptable to changing environments and new technologies, open to new ideas, and skilled at leveraging diverse perspectives to drive growth and improvement. Innovative leaders also place great emphasis on effective communication and collaboration. An online questionnaire was distributed to Master level students at two universities of applied sciences in Finland. The participants had several years of work experience as at least two years of relevant work experience after their first degree is required for them to be eligible to apply. The questionnaire was distributed to identify the traits of innovative leaders and the importance of organizational culture and values as elements of innovative leadership. The research aims to establish how various leadership factors, including understanding content technologies, communication with stakeholders, visionary thinking, and internal and external conditions, influence the effectiveness and innovation of leadership within an organization. The relationship between different aspects of leadership and their impact on organizational success and innovation are also examined in this study.

Key words: Innovation, Innovative Leadership, Innovative Leadership Traits, Organization, Enterprise

1. Introduction

Organizations need to produce innovative products and services for survival, sustainability and growth (Siakas et al., 2020). Innovation is seen as the main vehicle for value creation in business organizations and in society. The ability of an organization to innovate is strengthened when a culture of innovation is promoted through its organizational practices and organizational culture. Innovative leadership is a significant element in fostering innovation and creativity in organizations. It includes guiding individual employees and teams to generate and implement new ideas, which is imperative for maintaining a competitive advantage in the swiftly changing business environment (Kremer et al., 2019). The organizational culture is mainly created by strong leadership, a robust mission guided by a realistic vision, and strengthen by a value system that brings together employees around a shared purpose (Schein, 1986; Lampropoulos & Siakas, 2018). The organizational system that promotes innovation needs to include characteristics, such as encouragement of open communication, participation and collaboration, provision of resources enabling creativity, training, and exploration of innovative projects, incentives and recognition of open-mindedness, forward thinking, flexibility, as well as establishment of innovation goals. The changing environment and the increased utilization of smart technologies place new requirements on organizations to leverage diverse perspectives related to innovation, growth and improvement.

To gain advantage over competitors, development strategies of business organisations and even of nations are supported by the need for innovation (Sheriff et al., 2013). There is an assumption that innovation is positively correlated with value creation, which is the ultimate goal of every business and every human activity. The

literature suggests that organizations perceive innovation as integral for value creation and gained competitive advantage (Sheriff et al., 2013). Figure 1 shows the relationship between innovation, culture and value.

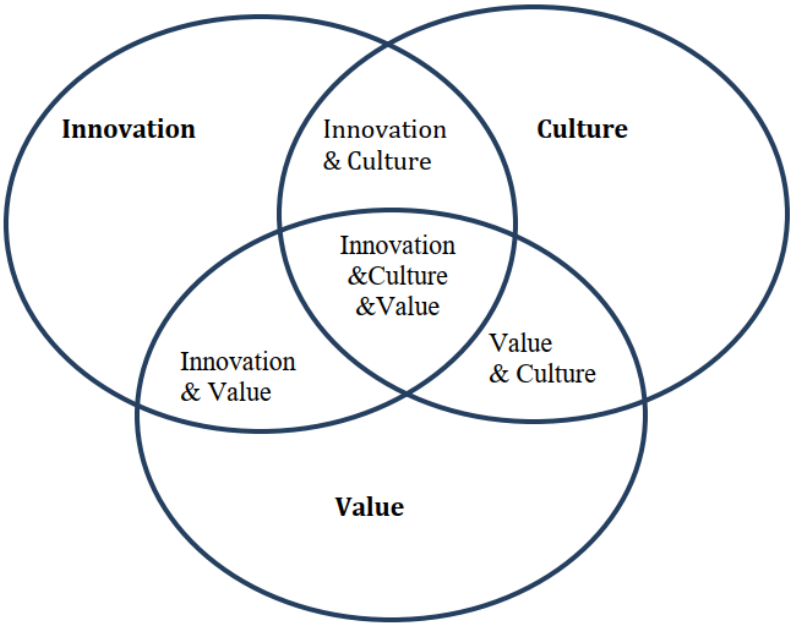


Figure 1: Conceptual framework relating Innovation, Culture and Value (Sheriff et al., 2013).

The interactions between Innovation, Culture, and Value can be classified into two main categories, namely interactions that enable the creation of opportunities (synergies) and interactions that create obstacles (tension) that needs to be mitigated. The innovative organization needs to capitalize on the synergistic factors and mitigate the factors that cause tension. The traits of innovative leadership are expected to offer a role model for strengthening innovative behavior of subordinates so that they can contribute to the competitive advantage of the organization. In this paper we investigate traits of innovative leadership by establishing various leadership factors that are identified to influence the effectiveness and innovation of organizations.

2. Literature Review

Three of the most important sources of organizational cultures are (Siakas, 2002) societal or national culture within which an organization is physically situated, the vision, management style and personality of the founder of the organization (or dominant leader), the type of business an organization conducts and the nature of its business environment (e.g. influence from stakeholders). Figure 2 shows the societal iceberg, which divides the organization into a formal and informal organization.



Figure 2: The Societal Iceberg (Siakas, 2002).

The idea of an iceberg represents a visible part of an showing the formal aspects of an organization while the informal aspects of an organization hide under water and are difficult to discover. The informal part is the greater part of the societal iceberg and will act to help or hinder an organizational process of change. It often leads to resistance to the change process. The structure (hierarchy) of the organization can be visualized to some degree by, for example, organizational charts, which show the roles and responsibilities in the organization. Goals and strategy are visible. They are planned, decided and documented and from this point of view visible. Products and services are also visible. Standards adopted and procedures applied are visible components of the formal organization, both in their documentation and in their use. Quality standards, for example, are document oriented in that procedures and processes in the organization have to be identified, documented and followed. Management is visible in the organizational chart, but management style and behavior are culture bound and thus difficult to recognize for an outsider. Thus, leadership and behavior belong to the informal organization. Another important factor for the success of the organization is financial resources, which can be divided into people and infrastructure resources. If enough people are employed and the latest technology is available, we still cannot predict to what degree the goals and objectives will be fulfilled. For the management of any workforce, but particularly for the management of a diverse workforce in a global organization, the underlying culture and norms of behavior must be understood to obtain commitment at all levels in the organization. Cultural studies are mainly concerned about fundamental values, attitudes, and beliefs. From an anthropological point of view, culture is considered to be static and changes only slowly over time. To understand an organization, both the formal and the informal features of an organization are essential. It is likely that it is more difficult to measure or assess the informal part of an organization. To create and maintain an adequate organizational culture, management activity and relationships, together with leadership and commitment, are significant factors.

Since leadership is culture bound, the traits of innovative leadership also need to be investigated through a cultural lens. Personal characteristics of innovative leaders comprise hard and soft personal competencies (Asrarudin, 2023), such as creative and positive thinking, problem solving skills, interdisciplinary understanding, as well as subordinate intrinsic and extrinsic motivation. Studies have suggested that innovative leadership is influenced by vision, trust, honesty and integrity, creativity, emotional intelligence, and adaptability (Afsar & Umrani, 2020; Javed et al., 2020; Lee et al., 2020; Asrudin, 2023; Adeel et al., 2024). It positively influences organizational innovation and performance by fostering a supportive environment, encouraging learning. It aims to leverage personality traits like agreeableness, cordiality and openness. Employee innovative behavior is a key factor contributing to long-term survival, self-sustainability, resilience and growth. Diverse leadership characteristics were examined and their impact on employee innovative work behavior and organizational performance: 1) *Innovative leadership (*leadership style that promote innovation and creativity to manage people and projects) has a positive relationship with sustainable performance, a combination of economic, social and environmental performance of thriving highly energized employees (Aman-Ullah et al., 2024).2) *Transformational leadership* (leadership style that empowers people to accomplish positive change through vision, inspiration, and action) has a positive impact on employees' innovative work behavior (Afsar et al., 2018). 3) *Transactional leadership* (leadership style of rewards and punishment) relates positively to organizational performance (Dong, 2023) 4) *Entrepreneurial leadership* (strategic thinking and resilience to communication and financial common sense) positively impacts on Corporate Sustainable Development (CSD) and firm performance through creativity, passion and motivation (Razzaque et al., 2022). Entrepreneurial leadership positively moderates the effects of creative self-efficacy (CSE) (the belief that one has the capacity to perform creative work effectively) on innovative behavior (Newman et al., 2018). 5) *Ethical leadership* (guiding people to make good decisions rooted in ethical values, such as fairness, morals, ethics, trust, honesty, accountability, equality, mutual respect, and honesty). Ethical leadership is a significant predictor of both individual and organizational creativity. For the individual level, the results of multilevel modeling indicate that there is a positive link between ethical leadership and employee creativity. Ethical leadership affects employee creativity through knowledge sharing and empowerment. At the organizational level, the results reveal that ethical leadership is positively associated with organizational innovation (Shafique et al., 2020).

As regards *creative performance*, authentic, empowering, and entrepreneurial leadership confirmed the strongest relationships. For *innovative performance*, both transactional (exchange or interaction between people) and supportive leadership appeared relevant. Mutonyi et al (2022) after testing a sample of 1008 hospital employees revealed that employee individual innovative behavior is related to organizational culture, internal market-oriented cultures and support for autonomy, all mediated through organizational attractiveness. Hence, they are significant drivers of employee perceptions of organizational attractiveness and their innovative behavior. Aschbacher and Sablik (2019) quote that leaders who employ a novel leadership style

can promote innovations. Sen and Eren (2012) argue that innovative leadership combines technology know-how with traditional leadership and management skills. They have described ten skills an innovative leader should possess. Firstly, technology skills are required, particularly know-how about technologies. Leaders must possess the ability to transfer technology knowledge to others through a deliberate process of sharing of knowledge, expertise and skills between individual employees and teams. Knowledge management includes certain organizational structures, processes, principles, and applications that support people in knowledge sharing and leveraging to meet business goals (Siakas & Siakas, 2020). Focus is placed on the individual, but simultaneously it highlights the wholistic character of creating, sharing and managing knowledge. Visionary leadership embrace a holistic understanding and expectation of future changes, including setting clear goals, producing a sense of purpose, and inspiring employees to take actions for actualizing the desired outcome (Karwan et al., 2023). According to Keeney (2008) value-focused thinking helps keep attention throughout the decision process on the aims of desired achievements. It helps define the decision problem in an explicit and clear manner and it inspires creative thinking in modelling the decision. Value-focused thinking enables the creation of alternatives, results in improved objectives for evaluating the alternatives, and proactively identifies more attractive decision opportunities. Leaders need willpower to promote a company into success. Leaders need to obtain followers inside a company. Ndonye (2022) emphasizes that the strategies, types and tactics of influence used by leaders in motivating others influence the achievement of goals and argues that there is positive correlation between leadership, followership, and organizational performance. Effective communication between leaders within a company. Marbun et al. (2023) emphasize that in order to achieve the goals of an organization effective communication is important. The ability to understand internal conditions. Organizational culture is stimulated by leaders to influence various aspects of organizational behavior (Siakas, 2002). According to Keeley et al (2013), the spectrum of innovation is wide and covers many business operations. Additionally, they claim that companies can innovate in ten different ways and they have grouped these approached into three areas, namely configuration, offering, and experience, in their framework. The framework emphasizes leaders should have business thinking from different perspectives reflecting general leadership and management skills.

3. Methodology

To examine the participants' responses and viewpoints regarding the importance of leadership in promoting a culture of innovation within companies, an online survey was created and distributed at two universities of applied sciences in Finland. The main basis for this survey was a previously presented framework by Sen and Eren (2012). The questionnaire was voluntary and anonymous. The data collection process consisted of an online questionnaire uploaded on the Webropol platform. The participants rated each item (variable) of attributes on a Likert scale of 1 to 5 where 1 meant "Not important at all" and 5 meant "Extremely important".

The questionnaire contained eleven background questions at the beginning of the questionnaire, such as age, gender, student status (university of study, full or part time), number of university years completed, work status, current position in workplace and the field of the degree. Ten questions regarding leadership were administered after the background questions. The last question was an open question asking what constitutes innovative leadership from the respondents' viewpoints. The questions and their grouping can be seen in Table 1. Descriptive statistics using SPSS were used to analyze the data of the responses of the 42 Finnish master's students who took part in this study.

4. Findings

The participants consisted of 17 female students (40.48%) and 25 male students (59.52%) in Finland who had an average age of 41 years and studied business management and administration as well as information technology and digitalization. Figure 3 shows most students were employed (n=35, 83.33%) with only a few being unemployed (n=7, 16.67%) at the time the survey was undertaken. Additionally, most participants were undertaking their master's courses as full-time students (n=25, 59.52%). The participants had an average of 18.36 years in working experience and most had 11-15 years of experience (28.57%), followed by those with 16-20 years of experience (21.43%) It can be concluded that majority of respondents had at least five years of work experience (95,24%) , which is in line with the fact that respondents were master level students in Finland, as work experience of at least two years is required for admission to a master's degree.

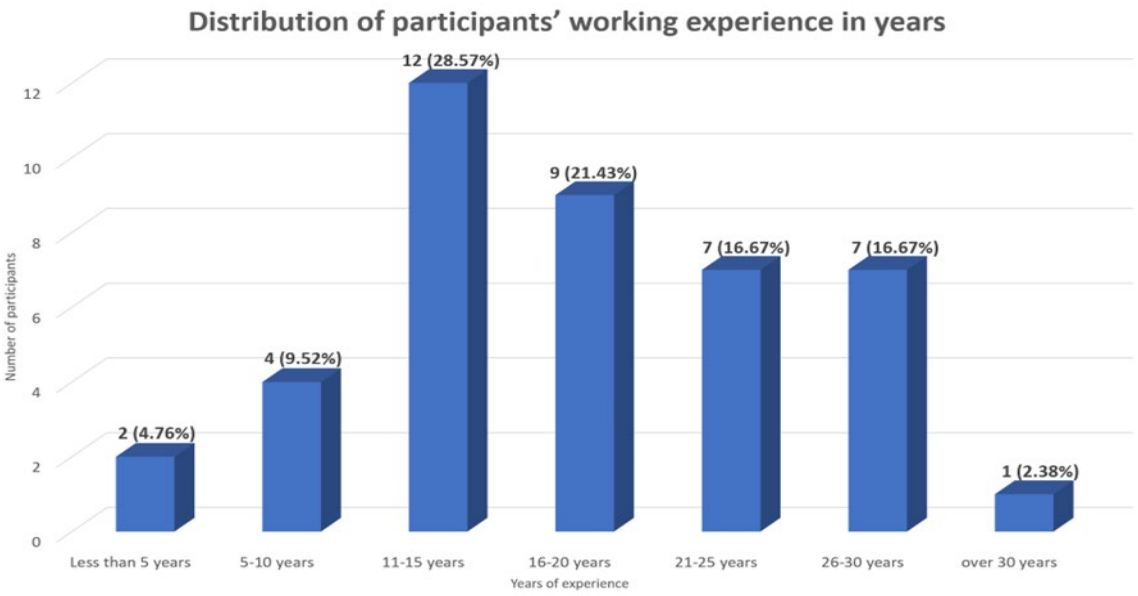


Figure 3: Distribution of participants' working experience in years.

Given their age and years of experience, when examining their seniority in their current or previous companies, most participants were mid-level employees (n=21, 50.0%). However, there were also 9 participants (21.43%) who worked as executives and 9 (21.43%) who had roles at an operational level. Three of the younger participants, who were currently unemployed, had less than 5 years of working experience, and were taking part in the master's program as full-time students, reported that they had no previous roles within a company that could be categorized within these three levels. It can be concluded that majority of the respondents possessed work experience supporting the understanding of a company culture, leadership and innovation. Furthermore, to acquire a better understanding of the participants' perspectives and experiences regarding the importance of leadership and its role in promoting innovation, ten Likert scale questions were set as. The findings are summarized in Table 1.

Table 1: Frequency of participant responses.

Groups	Questions: How important is it for leaders …	Not important at all	Not very important	Neutral	Quite important	Extremely important	Mean	Std. Dev.
Understanding & communicating content technologies	to understand the technologies used in the companies to effectively lead them?	0	1 (2.38%)	4 (9.52%)	25 (59.52%)	12 (28.57%)	4.14	0.68
	to communicate the use & value of these technologies to stakeholders (e.g., employees, customers, clients, & other interested parties)?	0	4 (9.52%)	7 (16.67%)	21 (50.00%)	10 (23.81%)	3.88	0.89
Leadership skills & attributes	to have skills, as visionary thinking, & the ability to analyze the company current status and future potential?	1 (2.38%)	3 (7.14%)	5 (11.90%)	16 (38.10%)	17 (40.48%)	4.07	1.02
	to understand & align with the company's core values?	0	1 (2.38%)	1 (2.38%)	17 (40.48%)	23 (54.76%)	4.48	0.67
	to showcase strong willpower &	0	2 (4.76%)	4 (9.52%)	24 (57.14%)	12 (28.57%)	4.10	0.76

Groups	Questions: How important is it for leaders …	Not important at all	Not very important	Neutral	Quite important	Extremely important	Mean	Std. Dev.
	commitment to their work?							
	to effectively manage both processes and people within the company?	0	3 (7.14%)	6 (14.29%)	27 (64.29%)	6 (14.29%)	3.86	0.75
Leadership dynamics &influence	to acknowledge the role of employees in shaping leadership within the company?	0	1 (2.38%)	17 (40.48%)	18 (42.86%)	6 (14.29%)	3.66	0.73
	to interact & communicate effectively with stakeholders to lead the company?	0	0	5 (11.90%)	18 (42.86%)	19 (45.24%)	4.33	0.69
Internal & external influences	to consider internal factors, e.g. organizational culture, in influencing leadership effectiveness within the company?	0	2 (4.76%)	5 (11.90%)	20 (47.62%)	15 (35.71%)	4.14	0.81
	to consider external factors, such as politics, economy, and societal factors, in influencing leadership effectiveness within the company?	1 (2.38%)	4 (9.52%)	13 (30.95%)	13 (30.95%)	11 (26.19%)	3.69	1.05

In all the questions, participants consistently emphasized the importance of leadership in increasing innovation and productivity. Specifically, participants highlighted that effective leadership required strong understanding of adopted technologies and used within the company (n=37, 88.10%) and the ability to effectively communicate with other stakeholders about these technologies and methods (n=31, 73.81%).

With regards to questions relating to attributes of leadership, the participants also highly regarded the importance of visionary thinking and analytical skills to evaluate the current state of the company and identify opportunities for further improvements and advancements (n=33, 78.57%). Moreover, participants vastly agreed that effective leadership required leaders to understand the core values of the company (n=36, 85.71%), demonstrate interest and commitment in their work (n=33, 78.57%), and be capable of managing and directing both processes and employees (n=40, 95.24%). They also emphasized that to effectively lead an innovation-driven company, leaders should be able to interact and communicate effectively with employees (n=37, 88.10%), as employees play a key role in shaping leadership within the organization (n=24, 57.14%). The employees playing a key role in leadership within the organization had, with regards to questions related to the attributes of the leadership, the lowest mean indicating it the least important of the attributes.

Participants highlighted that both internal conditions (n=35, 83.33%), such as organizational culture, and external factors (n=24, 57.14%), e.g., political, economic, and societal influences, significantly impact leadership effectiveness within the company. A strong and adaptable organizational culture is important for leadership success, while external conditions require leaders to remain flexible and responsive to ever-changing challenges. Internal factors had a higher mean value than the external factors, thus the respondents see the understanding of internal factors as more important than external factors.

An open-ended question for the participants to describe what makes leadership innovative was included in the survey. As it was not mandatory to answer this question, only 16 (38.10%) of the participants responded. Nonetheless, based on the participants' viewpoints on innovative leadership, several key characteristics and approaches that make leadership effective in fostering innovation are highlighted. Emphasis was placed on the importance of creativity, visionary thinking, and an open-minded approach, with leaders being able to think "outside the box" and leverage new technologies. It was also revealed that to foster innovation, it is essential to empower stakeholders and motivate employees to learn, adapt, and give feedback. A focus on leading change,

taking bold actions, and having a servant leadership attitude, which prioritizes the needs of others, was frequently mentioned.

Additionally, participants noted the importance of staying ahead of competition by researching and integrating new technologies, employing top talents, applying new approaches, enabling all employees to voice their opinions and innovate, and creating a culture that continuously adapts and evolves. The importance of flexibility, open-mindedness, a forward-looking mindset, and the ability to manage change effectively were highlighted as crucial in today's fast-paced, ever-changing world. Leaders were seen as essential in fostering a culture of collaboration, risk-taking, and ethical conduct, while ensuring value creation for the organization and its community. Encouraging diversity, openness to new ideas, and supporting a personal and individualized leadership approach were considered as ways to inspire creativity and continuous learning. Finally, the need to adopt an "experimental culture" where failure is embraced as a learning opportunity and to allow all employees, not just managers, to contribute ideas and solutions was noted.

5. Discussion

The understanding of technologies was seen important in this study. This finding is in line with the work of Sen and Eren (2012) who note that that innovative leadership combines technology know-how with traditional leadership and management skills. They note that innovative leadership should have technology skills are required, particularly know-how about technologies. Furthermore, they highlight the importance of communication and knowledge sharing, which also correlates to the findings of this study. Our findings are also aligned with the framework of 10 types of innovation presented by Keeley et al (2013) as they highlight that an innovative leader needs both traditional competencies and technological competencies to improve business through innovation.

The findings of this study of internal attributes, such as such as organizational culture, and external attributes of the organization playing an important role with regards to innovation activities is in line with the findings of Siakas et al (2020) who found that organizational culture is affected by business type an organization conducts and the nature of its business environment. Based on the outcomes, the mean value of the internal attributes was higher than that of the external attributes e.g. politics, economy, and societal factors.

6. Conclusions

The limitation of this study was the small number of respondents. However, the results show the most critical features of innovative leaders. These features should be developed in the case of any leader who wants to have growth through innovations for their company. General findings suggest leadership traits are associated with innovative leadership. Being aware of the leaders' traits can alter or improve employees' own leadership skills. An increased effort should be made to foster an organizational culture towards a more innovative driven and psychologically safe one, allowing for idea generation and other innovation activities (Brusila-Meltovaara et al, 2025). Based on the outcomes, diversity and service leadership also arose as key elements of innovative leadership which is in line with the outcomes of other related studies (Gomez & Bernet, 2019).

The significance of change management (Kotter, 1996) and servant leadership is also seen important. The other organization related traits confirm that innovative leadership is partly connected to organizational ambidextry. (O' Reilly & Tushman, 2013). Ambidextry refers to the ability to concurrently manage the existing business in an efficacious manner and to explore simultaneously novel markets, products, services, and technologies. Organizational ambidexterity enhances organizational performance in numerous ways (Taha et al, 2024). Our findings support the ambidextrial and servant leadership traits as innovative leadership traits.

Ethical traits were found to be important in an innovative leader, which supports the notion of ethical leadership, which again predicts both individual and organizational creativity. Ethical leadership also enhances employee creativity through knowledge sharing and empowerment. The findings are in line with Shaficute et al (2020) where at the organizational level, the results reveal that ethical leadership is positively associated with organizational innovation. Diversity, openness to new ideas, and supporting a personal and individualized leadership approach were considered as ways to inspire creativity and continuous learning. The findings confirm that management and leadership are entwined (Nienabler, 2010). The results also highlight the importance of creativity, visionary thinking, and an open-minded approach, with leaders being able to think "outside the box" and leverage new technologies. Furthermore, it is essential to empower stakeholders and motivate employees to learn, adapt, and give feedback to foster innovations. Change management, bold actions, and having servant

leadership attitudes, which prioritize the needs of others (Eva et al, 2019) is seen as important by respondents. The findings also suggest that innovative leadership traits should include adapting to the use of new technologies, employing top talent, providing a psychologically safe environment (Bernards et al, 2024; Kyambade et al, 2024) where opinions and suggestions are encouraged and thus a culture prevails for innovation and creativity. According to Johnson & Hackman (2018), highly competent leaders have good communication skills as well as the ability to listen. Our results demonstrate that the leadership of technology companies should understand content technology. Leading a company is challenging and complex. Hence, awareness of critical leadership factors can play a pivotal role in the success of a business.

Ethics and AI Declaration

This study did not require ethical clearance. AI-assisted writing was employed for grammar checking and paraphrasing. All interpretations were conducted by the authors.

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Integrating Entrepreneurial Mindset Education into a Midwifery Curriculum

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Abstract: Against the background of national media criticism of the maternity services, an attempt to illuminate the midwife's role as a change agent, was made in relation to the current literature on leadership. Whilst the concept of the change agent is discussed as a pivotal role in midwifery leadership, less is understood about the skills and attributes midwives need to develop, to become effective leaders. Moreover, even less is understood about the meaning of the change agent in the clinical environment, when change, a nebulous concept, is typically associated with senior management roles. Using a case study, the development and delivery of entrepreneurial mindset education for student midwives is explored in the context of professional identity and their role as future leaders; and is framed as a necessity for personal and professional growth and development. This paper will examine how the focus on Entrepreneurial Mindset Theory (EMT) presents a teachable framework, in which skills, attributes and behaviours, can be explored to illustrate the synergy between entrepreneurial skills and those expected of the professional midwife. Making enterprise education relevant to the professional role is crucial and not without its challenges, therefore aligning curriculum content with programme objectives for practice learning and the development of clinical proficiencies, is essential. Exploring the features and implications of adopting a growth mindset, enables students to understand the importance of developing a strategic approach to navigate complex systems and processes, and the relevance of a solution focused lens to address issues in an ever-changing and challenging maternity environment. This paper illustrates that integrating entrepreneurial mindset education into the midwifery curriculum at its core, offers students the opportunity to find clarity in their role and use their skills, knowledge and current evidence in a creative and innovative way to make change happen, confirming that adopting an entrepreneurial mindset is crucial to the professional role of the midwife and the future of midwifery.

Keywords: Midwifery, Change Agents, Leadership, Entrepreneurial Mindset Education

1. Introduction

The maternity services have come under increased scrutiny over the last 10 years because of high profile media cases and national enquiries (CQC 2024), with successive reports raising issues in relation to the safety and quality of services (Kirkup 2015; Ockenden 2020; Kirkup 2022). Concerns related to poor teamwork, communication and behaviour, together with a lack of learning from failure, has increased the focus on the effectiveness of maternity leadership and the preparation of future leaders.

Whilst leadership concerns in the maternity services are complex, the need to prepare and develop the leadership skills of all midwives, starting with student midwives, is paramount. The focus therefore on the preparation of student midwives for leadership, is emphasised in the current Nursing and Midwifery Council (NMC)(professional regulator) Standards of proficiency for midwives (NMC 2019). A focus on the midwife as a leader is clearly defined and illustrated by the proficiencies students are required to achieve for registration; however, students may have a varied and possibly limited experience of leadership within their clinical placements. As a means of strengthening their exposure to leadership, students are now required to gain a broader experience of leadership by undertaking placements in different National Health Service (NHS) hospitals. It is understood that observing different leadership styles and recognising the attributes of good leaders is important to support the student's understanding of leadership within the clinical environment. Moreover, positive role models have an impact on students style of practise and are often noted as professionally inspiring in preparing future midwives (Nieuwenhuijze et al 2020). However, whilst mentorship and supervision play important roles, Abdul Rahim et al; (2025) draw attention to the importance of self-awareness for the student and understanding personal skills in building confidence, and in identifying strengths and limitations through reflection. Uytenbogaardt (2020:141) states: *'By equipping midwives with the skills and knowledge on how to successfully lead in practice, it will ensure high quality service and create a positive working environment for all staff.'* A recent international study by Pezaro et al; (2024) reinforce the benefits of transformational leadership in which the characteristics of effective decision making, resilience and compassion, amongst others, are important attributes for strong midwife leaders.

By exploring leadership skills and the implications of leadership for the safety and quality of care with students, the role of the midwife leader as a change agent becomes central to the discussion of service improvement. The aim of this paper is to illuminate how the role of the change agent in the clinical environment reflects an

entrepreneurial intention, illustrating the synergy between entrepreneurial skills and those expected of the professional midwife in driving change. The discussion will introduce the application of Entrepreneurial Mindset Theory (EMT) as a teachable framework, with a focus on skills, attributes and behaviours followed by a case study in which the development and delivery of entrepreneurial mindset education for student midwives will be discussed.

2. The Leader as a Change Agent

The change agent is described as a role in which creativity and vision can be used to improve the quality of maternity care (Byrom & Downe, 2010; Divall 2015), and illustrates the relationship between effective leadership and change management. Medway & Rehayem (2023:5) suggest that *'…midwifery leadership is key to being a powerful driver of change. It is something all midwives can and need to engage in*.' Naccarella, Butterworth & Moore (2016) propose however that the role of the change agent can be defined in relation to whether they initiate, lead or facilitate change. Furthermore, Welker et al; (2014) confirm that change agents are effective if they are transformational leaders working within positive working environments. When their role is fully recognised as an added value, change agents can motivate colleagues and drive change forward. Kumar et al; (2015) add that a change agent can be a critical factor for success for the organisation, when they are passionate about implementing change.

However, De Leo et al; (2019) in the review of midwives' use of best available evidence, report that change leader midwives experience challenges in attempting to initiate innovation in practice and conclude that an unsupportive work environment and poor interdisciplinary collaboration are major barriers to support change and innovation. McCormack et al; (2013) suggest that change agents need a well-resourced supportive environment to become effective drivers of change. Stefancyk, Hancock, Meadows (2013:14-15) further describe the context in which the change agent operates: *'…encourages the staff to share in decision making and change by promoting the exploration of creative solutions. When ideas are allowed to germinate, it generates enthusiasm and further creativity. Facilitating creative thinking enhances the process of finding the best solutions and ways to sustain the change. Again, a healthy work environment is essential to this process, as it builds a culture of trust where one can explore ideas.'*

Whilst the conditions required for successful change are complex and influenced by a multitude of internal and external factors, nurturing leadership attributes is pivotal for effective midwifery leadership, and motivation to make a difference is key (Adcock, Sidebotham & Gamble 2022). McCormack et al; (2013:8) also suggest that; *'…a change agent who has a positive attitude, with well-established respect and credibility, seems more likely to be able to build a critical mass of leadership influence, solicit the required resources from leadership, and establish the necessary supportive culture*.'

2.1 The Change Agent and Entrepreneurial Intention

Given this context, the role of the change agent reflects an entrepreneurial intention as a professional imperative to improve quality and safety. Whilst the use of the terms entrepreneurship and enterprise education are used interchangeably in the literature, and an in-depth discussion is beyond the remit of this paper, the definition of entrepreneurship offered by the Entrepreneurial learning initiative (2021:4) resonates with the midwife as a change agent and offers an overarching philosophy in relation to social value; *'…entrepreneurship as the self-directed pursuit of opportunities to create value for others…entrepreneurial activity is not limited to new venture creation but also includes those who identify opportunities to create value within established institutions and organizations.'*

It is clear, that the focus on the change agent in this context is preoccupied with driving change and service improvement from within. As a result, many positions within the maternity services in the UK (e.g. Consultant midwives), have been developed to address specific aspects of care for vulnerable populations which mainstream services have not been able to address. Whilst midwives in these positions could be described as intrapreneurs, many do not identify with the term. This may not be surprising, since the inclusion of entrepreneurship education in healthcare programmes is uncommon in the UK. Although midwives as well as nurses have a long history of independent practice, product design and development, and service change and quality improvement, this remains an under researched area (Drennan et al; 2007). Despite limited but interesting literature on embedding enterprise and entrepreneurship education in healthcare education globally (Salminen et.al; 2014; Refai & Thompson 2014), the focus in midwifery has received limited attention in the UK literature. The synergy between entrepreneurial skills and the expectations of the midwife as a change agent,

therefore, appear to be an appropriate and relevant way to introduce student midwives to the value and benefit of enterprise education. Whilst the use of enterprise and entrepreneurship education are used interchangeably, the use of enterprise education is used here to reflect the focus on behaviours, skills and competencies defined by the Quality Assurance Agency (2018:9); *'Enterprise Education is defined here as the process of developing students in a manner that provides them with an enhanced capacity to generate ideas, and the behaviours, attributes, and competencies to make them happen. It extends beyond knowledge acquisition to a wide range of emotional, intellectual, social, cultural and practical behaviours, attributes and competences, and is appropriate to all students. These are all underlying factors that can enhance employability prospects as well as be taken further through Entrepreneurship Education*.'

In this context, the use of enterprise rather than entrepreneurship education, highlights the focus on preparing students for complex working environments, which strengthens the focus on skills development. To support this, the focus on exploring mindsets and especially entrepreneurial mindset, acts to provide a framework for students, accepting that an awareness and development of an entrepreneurial mindset can be beneficial to both their personal lives as well as their professional careers. Whilst there are numerous definitions in the literature (Daspit, Fox & Findley 2023), for this paper, an entrepreneurial mindset is defined as; *'… an innovative approach to thinking and doing; the acquisition of an attitude and skill set that encompasses resilience, calculated daring and initiative…the common attributes associated with an entrepreneurial mindset include creativity, empathy, resilience, self-sufficiency and the ability to learn from failure.'* (De Carolis and Litzky 2019: 60).

In the first of two sections, an introduction to Entrepreneurial Mindset Theory (EMT) as a teachable framework is discussed and will be followed by a case study on the development and delivery of entrepreneurial mindset education for student midwives, framed as a necessity for personal and professional growth and development.

3. Entrepreneurial Mindset Theory (EMT)

The Entrepreneurial learning initiative (2021:20) suggests that; *'… entrepreneurial mindset theory assumes that the entrepreneurial spirit is the human spirit, it resides within all of us. The development of entrepreneurial attitudes, behaviours, and skills is largely dependent upon social, environmental, and situational factors rather than dispositional traits… and that the cultivation of these inherent tendencies is necessary not only to adapt and thrive in a rapidly changing world but also for economic prosperity and greater psychological well-being.'*

It is therefore focused on the understanding that people have the inclination to be innovative and entrepreneurial to solve problems and challenges in everyday life, and in this context, it reflects a humanistic view of entrepreneurship. It stresses the importance of the individual's responsibility to determine how to be useful to others, and that by doing so, they empower themselves. Key aspects of the theory which are relevant here focus on an underlying humanistic approach to solve problems, contributing to making people's lives better with integrity, honesty and truthfulness. This resonates with the midwife's role as a professional and as a change agent.

The Entrepreneurial Mindset Theory presented here as a teachable framework is influenced by the work of Entrepreneurial learning initiative (2021) as stated above but also developed in a practical context with the work of Coyle (2023). Firstly, to draw on the theoretical discussion of the Entrepreneurial learning initiative (2021) the entrepreneurial mindset is underpinned by five dimensions of mindset (Entrepreneurial learning initiative 2021) (Figure 1); each of which makes a specific contribution to the student's development of attributes and behaviours and draws on the relationship between how observable behaviour is influenced by deeply held beliefs that require further exploration. Students are presented with an opportunity to explore what factors may influence and contribute to their way of thinking, exploring issues which may impact their progress and success in their careers and aspects of their personal lives.

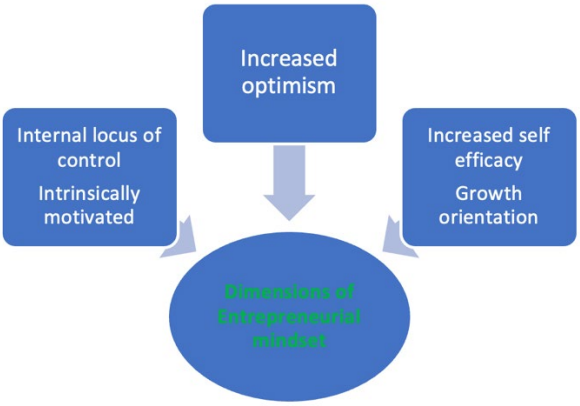


Figure 1: Five dimensions of entrepreneurial mindset

(Author's interpretation and illustration)

The work of Carol Dweck in relation to growth mindset is particularly significant here as Kolyda (2023:2) suggests that it *'…helps students cope with setbacks and embrace undeveloped success strategies perseverance and resilience.'*

Secondly, the practical definition of the entrepreneurial mindset proposed by Coyle (2023) illustrates the importance of seven essential entrepreneurial behaviours illustrated by the letters in the word MINDSET (Figure 2). These behaviours further illustrate the application of an entrepreneurial mindset as a practical and achievable process which enables students to consider the practical application of the entrepreneurial mindset.



Figure 2: Definition of the Entrepreneurial Mindset

(Resource: Coyle 2023; https://entrepreneurial-mindset.network/#mindset-definition)

4. Case Study: Entrepreneurial Mindset Education in Midwifery

Enterprise education is considered a tool to prepare students for changing environments. The integration of enterprise within the midwifery curriculum was proposed in 2019. With the publication of the new Standards of proficiency for midwives (NMC 2019), a mapping exercise was undertaking in which the NMC standards were mapped against the EntreComp competencies for enterprise education (https://entrecompeurope.eu/). This mapping exercise revealed a close alignment of skills and formed the justification for further development.

4.1 Design

The programmes offered in midwifery include a 3-year BSc (Hons) Midwifery and 2-year Postgraduate Diploma Midwifery. Each programme has a curriculum based on an accredited modular structure, in addition to practice placement experience. As the first University to consider enterprise education for midwifery students and in the absence of any previous examples, the aim from the outset was to design an offer in which the content was relevant to the midwife's role, demonstrating usefulness, importance and applicability. Since enterprise education was not reflected in the NMC (2019) standards, it was decided that enterprise sessions would be 'a

value added,' scheduled within practice modules and followed up in consolidation weeks at the end of an academic year.

Two specific design issues were noted at the time:

1. A series of sessions on their own would be considered of limited relevance for the students and the evaluation of impact would be challenging.
2. The timing and content of the sessions needed clear alignment with the student's knowledge and practice experience, to be of relevance.

4.1.1 Certificate of Enterprise in Midwifery

An optional Certificate of Enterprise in Midwifery was created to award students for engaging with and demonstrating their entrepreneurial mindset throughout their programme. Students identify, attend or participate in six events or activities and submit six pieces of evidence (100 words each) to demonstrate the relevance for their learning and development. An examination of the practice learning requirements for each year revealed an alignment with expected learning in practice. For this reason, students on the three-year programme submit two items of evidence at the end of each year with a focus on the themes illustrated in Table 1 and students on the two-year programme submit three items of evidence (Table 2).

Table 1: Skill development themes by year for BSc (Hons) Midwifery 3-year programme

Year 1: Developing personal and professional skills
Year 2: Teamwork & collaboration
Year 3: Preparing for registration & midwifery career

Table 2: Skill development themes by year for Postgraduate Diploma in Midwifery 2-year programme

Year 1: Establishing professional skills, teamwork, collaboration
Year 2: Preparing for registration & midwifery career

At the end of each year, students are awarded a Statement of Enterprise Engagement (SEE) for the evidence submitted. At the end of their programme when six pieces of evidence are completed, students are awarded the Certificate of Enterprise in Midwifery.

4.2 Delivery

Enterprise education has now been offered since 2022. Classroom sessions are offered 2-3 times every year with content specially designed to reflect the student's knowledge and practice and are aligned with the completion of evidence for the Certificate of Enterprise in Midwifery (see Table 3). Tutorials are offered on an ad hoc basis to support student queries and support engagement with enterprise activities and competitions. Additional enterprise sessions are included in mandatory modules e.g. leadership and quality are discussed in the final year of both programmes.

Table 3: Enterprise Education offer for BSc (Hons) Midwifery 3-year programme

Year Of Study	Session Titles	Certificate of Enterprise Theme
Year 1	Introduction to Enterprise Education Developing your entrepreneurial skills for midwifery practise: recognising the mindset	Developing personal and professional skills
Year 2	Entrepreneurial mindset and behaviour in cultivating a creative approach to problem solving. Innovation in midwifery: exploring the experience of a midwifery entrepreneur	Teamwork & collaboration

Year Of Study	Session Titles	Certificate of Enterprise Theme
Year 3	How to view autonomy with an entrepreneurial mindset The importance of an entrepreneurial mindset behaviour and leadership An entrepreneurial mindset and the midwife professional registration and beyond	Preparing for registration & midwifery career

The introductory session in year 1 is key to identify the diversity of skills and work experience within the student cohort especially business experience and online platform selling. This is a good basis for students to consider how these skills can be useful for the midwifery role. In addition, students are actively encouraged to attend sessions delivered by the enterprise team and enter Ignite competitions and participate in marketplace events. In year 2, students work in non-maternity placements (e.g. medical), where they focus on team working and problem solving and consider the application of knowledge to address different patient problems. Relationships with midwife entrepreneurs have developed over the years and they are invited to speak to the students to discuss their experience of being intrapreneurs and entrepreneurs. The focus in the final year of both programmes is leadership and the midwife's role as a change agent and quality improvement. Reflecting on the learning in previous years, sessions focus on the importance of the role of the midwife and professional identity. There is also a focus on the importance of recognising the significant aspects of professional registration and career development.

4.3 Student Evaluation

Of the two cohorts of students who have completed their programmes since 2022 eleven students have completed the Certificate of Enterprise. Verbal comments at the end of sessions were very positive and encouraging, including; *'I hadn't thought of that,' 'I have always wanted to change things for the better,' 'Thank you for inspiring me.'*

Evaluation comments were received from three of the eleven students who completed the Certificate of Enterprise. Each one rated their overall experience as excellent. All three wanted more sessions to focus on topics such as: *networking skills, meeting more intrapreneurs and entrepreneurs.* One student wanted more specific information on midwifery innovations: *developing outreach programmes for underserved communities, creating sustainable maternal health solutions and learning from more midwives with independent practises or NGOs*

Students were asked to consider the extent to which learning about an entrepreneurial mindset had developed them professionally. Comments were very positive and encouraging and included:

- *Just think creatively, problem-solving skills, adapt and collaborate with others working as a member of a team*
- *Learning about an entrepreneurial mindset has significantly contributed to my professional development by enhancing my problem-solving skills, adaptability and proactive approach to work. To mention few key ways that has helped me grow professionally, I have learnt to approach challenges with a solution orientated mindset rather than viewing them as obstacles. I have developed proactiveness and initiative, I now take ownership of tasks and seek opportunities to contribute; initiating a mentorship programme to support new employees which improved team cohesion and productivity*
- *Increased my resilience: improved ability to cope with setbacks and learn from failures.*

Students were very appreciative of the opportunity

- *I would like to express my thanks and appreciation for being part of the enterprise programme*
- *Enjoyed the enterprise learning and the opportunity.*

One student highlighted the potential for further development and suggested: *Weekly or termly workshops: hands on training in leadership innovation and problem solving*, *deep dives into patient engagement networking and communication*, *more extensive topics such as financial skills decision making and business development* and *intensive training with guest speakers and case studies.*

5. Discussion

Whilst enterprise education has a long history in higher education in the UK (Pittaway et.al; 2024), this paper has illustrated that integrating entrepreneurial mindset education into the midwifery curriculum at its core, is an innovative and evolving contribution. It offers students the opportunity to find clarity in their role and use their skills, knowledge and current evidence in a creative and innovative way to make change happen. Although student evaluation is limited and a major shortcoming at present, student comments indicate that entrepreneurial mindset education offered in this way, is acceptable and well received. Some may argue that the use of entrepreneurial mindset education to underpin effective leadership and to drive quality improvement is at present, theoretical. As formal evaluation of all student engagement with enterprise education is currently scheduled, this together with further research, will be key to shape the development of enterprise education and to determine its impact on maternity services. Focused networking with professional organisations and academic colleagues is needed to raise awareness.

With an already full curriculum, the idea of entrepreneurial mindset education as an integral contribution to midwifery education may be challenged. Enterprise education is associated with business and not non-traditional programmes, especially in health. In the absence of literature in midwifery and recognising that enterprise education in nursing is not offered in the UK, the focus of international literature in nursing, appears to be on entrepreneurship and innovation related to business creation and employability. Although entrepreneurship education has received less attention in the nursing literature, the importance of education has nevertheless been highlighted to prepare students. Whilst mandatory and optional courses, extracurricular courses and certificate programmes are noted in the literature, content is considered theoretical and insufficient to demand curriculum changes in nursing programmes (Gardim et.al; 2024). However, Rahmanianaraki et.al (2024:221) states that 'the lack of entrepreneurship education during nursing school is a significant obstacle.' They call for more entrepreneurship education to enable students to be more familiar with concepts and call for a review of nursing curricula.

The current structure and presentation of entrepreneurial mindset education are likely to be influenced by further student evaluation, developments to the curriculum due to NMC standards and strategic influences from external sources (e.g QAA, Advance HE). This will be an opportunity to further map content across mandatory modules to create a coherent offer for student midwives throughout the programme. Further emphasis on the use of interactive and experiential learning will require the review of class sizes and the learning environment. However, as education provision is developed, students will need further exposure to innovative midwives in clinical practice and observe their impact on the development of maternity services and midwifery care. As the main aim is to increase the number of intrapreneurs in the NHS, it is important to note that with workforce and workload challenges, opportunities for innovation and improvement may be limited (Bailey & West 2021). However, an increasing awareness of the NHS Clinical Entrepreneurship programme (https://nhscep.com/the-programme/) within clinical practice, will have a pivotal role on the development and provision of future enterprise education at undergraduate and postgraduate level and increase the visibility of innovation in clinical practice. Building a larger network of clinical midwifery intrapreneurs and entrepreneurs will expose student midwives to the value and contribution of an entrepreneurial mindset.

6. Conclusions

In summary, the paper has contextualised the introduction, design and delivery of entrepreneurial mindset education in midwifery. The relationship between the development, application and relevance of entrepreneurial mindset skills and the role of the midwife as leader and change agent in the midwifery context, is clearly illustrated. Whilst student evaluation of its current structure, presentation and impact is limited at present, the focus on Entrepreneurial Mindset Theory (EMT) as a teachable framework appears very promising. With further evaluation and research, a more persuasive case for the development and integration of entrepreneurial mindset education in midwifery, can be made. The case study presented in this paper, has suggested that adopting an entrepreneurial mindset is crucial to the professional role of the midwife and the future of midwifery. The concept appears sound, relevant and applicable to the midwifery role, but further work is needed to raise the profile of entrepreneurial mindset education within the profession.

Ethics Declaration

Ethical clearance was not required

AI Declaration

No AI tools were used in the creation of this paper

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Transforming Science into Business: Science-Business Roadmap for University-Based Scientific Entrepreneurship

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Abstract: Scientific entrepreneurship has become a fundamental pillar for innovation and economic development, especially in countries seeking to strengthen their technological production. However, the journey for researchers to transform science into business still presents significant challenges, including a lack of knowledge about innovation processes, limited access to professional networks, insufficient information on accessing financial resources, and difficulties in structuring viable business models. This study, part of an ongoing postdoctoral research project, proposes the application of the Science-Business Roadmap, a tool designed to guide researchers through the scientific entrepreneurship journey. The framework structures the entrepreneurial process, from identifying market opportunities and challenges to securing financial resources, implementing open innovation, and scaling research-based businesses. The study builds upon insights from research published at the European Conference on Innovation and Entrepreneurship (ECIE) – Innovation and Entrepreneurship of Professors in Public Universities: Case Study in Brazil – which resulted from a doctoral thesis analyzing the experiences of successful entrepreneurial professors in Brazilian public universities. Based on these findings, this research presents the validation of the Science-Business Roadmap as a practical tool to support researchers in transitioning their research from academia to the market. Initially applied at the Federal University of Pernambuco (UFPE), the tool can be used by researchers from various fields of knowledge. Its implementation and validation include interviews, workshops, and user monitoring. Beyond providing a structured model to increase the success rate of entrepreneurial initiatives in public universities, this tool fosters innovative businesses, expanding the impact of academic research. Additionally, this tool plays a crucial role in training scientists and researchers to become successful entrepreneurs, connecting them with companies, investors, and other key stakeholders in the innovation ecosystem. This approach aims not only to generate economic and technological impact but also to strengthen the culture of innovation and scientific entrepreneurship in Brazil and beyond, facilitating strategic partnerships and fostering an environment conducive to transforming science into innovative businesses and driving the growth of deep tech companies.

Keywords: Scientific Entrepreneurship, Deep Tech, Open Innovation, Academic Spin-off, Knowledge and Technology Transfer

1. Introduction

The transformation of scientific knowledge into tangible innovation represents one of the most significant challenges and opportunities for 21st-century universities (Borges et al., 2021). The so-called “third mission of universities” (Etzkowitz, 2008) expands the role of higher education institutions beyond teaching and research, incorporating the responsibility of generating economic, social, and technological impact through entrepreneurship and innovation. In this context, strengthening scientific entrepreneurship has become a strategic pillar for countries seeking to develop a knowledge-based economy, with emphasis on the role of public universities in generating emerging technologies and deep tech companies.

However, the path from science to market is filled with barriers. Researchers often face obstacles such as a lack of entrepreneurial training, insufficient knowledge about innovation processes, a lack of institutional support, and difficulties in accessing financial resources. These gaps hinder the full realization of universities' innovative potential and limit the creation of science-based businesses. To overcome these challenges — especially in the Brazilian institutional context — it is essential to provide practical tools that can guide scientists in their entrepreneurial journey from academia to the market, connecting research, innovation, and industry.

This article presents the validation of the Science-Business Roadmap (SBR), a tool developed from the roadmapping methodology (Phaal and Keer 2001) applied in a doctoral thesis on the trajectories of entrepreneurial professors in Brazilian public universities (Coelho, 2022). The SBR was conceived as a strategic decision-making support instrument for researchers seeking to transform their discoveries into impactful solutions, thereby structuring the process of developing science-based businesses. This study, derived from an ongoing postdoctoral research project, aims to validate the SBR with researchers from different fields by applying a questionnaire that explores the maturity stage of their projects, entrepreneurial competencies, and perceptions of the tool’s applicability.

The following section presents the theoretical background on scientific entrepreneurship, followed by an overview of the national and international landscape, the SBR validation methodology, and analysis of the results in five sections. Finally, the conclusion offers a reflection on the role of the SBR in institutionalizing scientific entrepreneurship within Brazilian universities, contributing to the strengthening of innovation ecosystems, the expansion of connections between science and market, and the development of academic leaders committed to sustainable development and technological transformation.

2. Theoretical Background

Scientific entrepreneurship emerges as a strategic strand of knowledge-oriented innovation, being especially relevant in public universities that concentrate most of the scientific production in countries like Brazil (CGU, 2023). By encouraging the creation of academic spin-offs (SOAs), technology-based startups, and university-industry partnerships, higher education institutions expand their activities beyond academic production, directly contributing to regional economic and technological development (MIT Sloan Management, 2025).

Authors such as Shane (2004) and Etzkowitz (2008) argue that the active involvement of professors in entrepreneurial activities increases the efficiency of technology transfer and enables the generation of wealth from science. However, for this potential to be realized, incentive policies, institutional support, and methodological tools are required to support the researcher's entrepreneurial journey — from identifying opportunities to business modeling, fundraising, and market validation.

In this context, roadmapping methodologies have been widely used to structure innovation trajectories and guide strategic decision-making (Phaal and Keer 2001). In her doctoral thesis, Coelho (2022) proposed the KTTRM (Knowledge and Technology Transfer Roadmapping Methodology), based on the analysis of cases of entrepreneurial professors in Brazilian public universities who successfully transformed scientific research into high-impact businesses. This methodology allowed the mapping of competencies, strategies, and knowledge and technology transfer (KTT) channels, revealing the critical success factors in these trajectories.

The SBR, the subject of study in this article, is directly derived from this methodology and constitutes a practical tool for planning, structuring, and accelerating scientific ventures. By articulating the insights from KTTRM in relation to current demands for open innovation, deep tech, and collaborative ecosystems, SBR aims to support researchers in developing innovative solutions from their research, thereby promoting economic and social impact.

3. The Landscape of Scientific Entrepreneurship in Brazil and Worldwide

Scientific entrepreneurship has gained global prominence as a vector for transforming academic research into high-impact technological solutions. However, institutional, cultural, and financial contexts vary significantly across countries, directly affecting the conditions for creating and scaling deep tech companies and academic spin-offs (ASOs). Cultural traits play a key role in shaping entrepreneurial attitudes, intentions, and education, influencing the effectiveness of entrepreneurship programs across different countries (Fleck, Kakouris, & Winkel, 2021).

The most recent data from the Global Entrepreneurship Monitor (GEM) 2024/2025 – Global Report reveals an ambivalent scenario in Brazil (GEM, 2024). On one hand, there is a high motivation to undertake entrepreneurial ventures: 74.6% of Brazilian adults indicate a desire to "make a difference in the world" as a motivation for entrepreneurship. In contrast, 69.3% cite the desire to "build great wealth or high income." Additionally, nearly half of the adult population (49.8%) demonstrates entrepreneurial intentions. On the other hand, only 46.1% believe it is easy to start a business, and 51.5% express a fear of failure, reflecting a still high perceived risk.

Among researchers affiliated with Brazilian federal universities, a relevant statistic extracted from the report by the Office of the Comptroller General (CGU), the agency responsible for auditing public spending in the country, indicates that 47% express interest in creating ASOs. This figure reinforces the latent potential for transforming research into innovation but also highlights that the ecosystem still lacks systemic support to convert this interest into established ventures. The CGU (2023) also underscores the challenges universities face in aligning their academic structures with the demands of a more dynamic and market-oriented innovation ecosystem.

A growing body of evidence highlights the strategic role that universities can play in regional economic development by fostering academic entrepreneurship. According to Fiona Murray, Associate Dean for Innovation at MIT Sloan, "The talent is there. It's just about building the systems and the culture that let it shine."

A recent study shows that American universities not only train PhDs in cutting-edge research but also embed innovation and entrepreneurship directly into their programs, helping students patent their discoveries and launch startups, bringing science to market. This model demonstrates that when institutions encourage faculty to pursue impact and engage PhD students in commercialization, they become engines of inclusive growth and innovation. This alignment between research, training, and regional economic needs allows universities to transform scientific knowledge into tangible social value — a lesson that can inspire similar strategies in Brazil and other emerging innovation ecosystems (MIT Sloan Management, 2025).

A study conducted with all ASOs of the Federal University of Minas Gerais (UFMG) found that the number of technologies transferred to ASOs represented 5.3% of the total protected Intellectual Property assets between 2001 and 2022. Moreover, the participation of UFMG researchers/professors in the creation of ASOs was associated with greater success in technology transfer, as well as higher returns for the university. For ASOs with participation from university researchers and professors, the average receipt of royalties/access fees was seven times higher than the average observed for other companies that are not ASOs. Additionally, among academic entrepreneurs, it was found that article production per year after the founding of the ASO remained equal to or increased in 75% of cases, with an average increase of 28% in the number of publications per year following the company's founding (Rabelo et al., 2024).

However, Brazil still faces structural barriers to scaling this model broadly. Nonetheless, initiatives such as those supported by the Brazilian Funding Authority for Studies and Projects (FINEP) — a public institution linked to the Ministry of Science, Technology, and Innovation (MCTI), responsible for promoting innovation and scientific research in Brazil — have sought to bridge the gap between academia and the market. According to the eBook from the I Deep Tech Brazil Seminar, promoted by FINEP and partners (2025), deep techs account for 25% of Brazilian startups but face bottlenecks in funding, entrepreneurial training, and engagement with the productive sector. The publication also emphasizes the importance of developing platforms and programs that support the journey of scientific entrepreneurs, informed by data, market intelligence, and strategic guidance.

In this context, tools like SBR become even more relevant. They not only help structure the journey of the scientist-entrepreneur but also contribute to the creation of a more proactive, connected, and results-oriented innovation culture. By combining practical guidance, strategic visualization, and integration with ecosystem actors, the roadmap helps ensure that Brazilian scientific talent can truly “shine,” as Murray suggests — provided robust and collaborative institutional structures support them.

4. Methodology

This study adopts a qualitative and quantitative approach to validate the applicability of the SBR as a support tool for the entrepreneurial journey of university researchers. The methodology is grounded in an applied and exploratory research logic, focusing on analyzing the use of the SBR by scientists and researchers from Brazilian public universities, particularly within the context of science- and technology-based ventures.

The validation of the SBR was conducted through a structured questionnaire, designed based on the dimensions and competencies identified in the KTTRM methodology (Coelho, 2022; Coelho and Rapini, 2022), which inspired the tool’s structure. The questions aimed to investigate the maturity level of scientific projects, the entrepreneurial competencies perceived as most important and most practiced, the challenges faced, and the participants’ receptiveness to SBR.

The form was made available online using Google Forms, comprising 20 questions (closed, mixed, and open-ended). A total of 20 academic researchers and entrepreneurs from Brazil were invited to complete the form. We obtained 13 valid responses from researchers affiliated with six federal public universities in Brazil: Federal University of Pernambuco (UFPE), Federal University of Ceará (UFC), Federal University of Minas Gerais (UFMG), Federal University of Goiás (UFG), Federal University of Uberlândia (UFU), and Federal University of Technology – Paraná (UTFPR). Among these, 3 researchers were from UFG, 3 from UFPE, 2 from UFMG, 2 from UTFPR, 2 from UFU, and 1 from UFC. Participants’ innovation projects were at different Technology Readiness Levels (TRLs), and they came from diverse fields of knowledge: 6 from Information Technology; 2 from Biotechnology and Health; 2 from Artificial Intelligence and Data Analysis; 1 from Industry and Manufacturing; 1 from Software Engineering; and 1 from Education.

The analysis included descriptive statistical treatment of the quantitative data, cross-referencing perceived importance and actual practice of entrepreneurial competencies, as well as thematic categorization of the open-

ended responses. The data were organized using graphical visualization tools to facilitate the interpretation of the results and their relation to the SBR structure.

5. Results and Discussion

The following section presents the main findings from the validation of the SBR, based on the 13 valid responses obtained from the research questionnaire. The results are organized into five main sections: (i) institutional profile of the respondents; (ii) project stages and areas of focus; (iii) evaluation of entrepreneurial competencies; (iv) perceptions of SBR format; and (v) functional and strategic evaluation of SBR: perceptions and proposals for improvement. This structure allows integrated analysis of SBR's applicability, considering contextual and individual aspects of researchers' trajectories.

5.1 Institutional Profile of the Respondents

The qualitative responses indicate that participants come from institutions with varying levels of maturity in terms of innovation and scientific entrepreneurship. Respondents from universities such as UFU and UFC reported recent institutional advances in innovation rankings and expansion of their patent portfolios, indicating a favorable environment for adopting tools like the Science-Business Roadmap. UTFPR was noted for its technological culture and close ties to the productive sector, being identified as an institution where the tool could potentially be incorporated by the university's Office of Business Relations.

Many participants also emphasized the importance of the tool offering personalized alerts and integration with communication channels such as WhatsApp and email, to expand access to relevant opportunities. There was also institutional interest in using the SBR as a tool for mapping entrepreneurial profiles, reinforcing its strategic potential not only as an individual planning tool but also as institutional support for innovation management in Brazilian public universities. These elements suggest that SBR addresses a concrete gap in supporting researchers' entrepreneurial journeys and can be integrated into institutional innovation policies.

5.2 Project Stages and Areas of Focus

The data indicate significant diversity in the Technology Readiness Levels (TRLs) of participants' projects or ventures. Most respondents classified their projects between TRL 4 and TRL 7, which corresponds to the stages from laboratory concept validation to prototyping in relevant environments—suggesting that SBR is especially useful in the intermediate phases of technological development.

The project areas were also diverse, including Information Technology, Artificial Intelligence, Software Engineering, Biotechnology, Health, Manufacturing, and Education. This demonstrates the SBR's cross-disciplinary potential in supporting researchers from various fields, highlighting its adaptability and applicability in multiple scientific and technological contexts.

Additionally, it is worth noting that participants were affiliated with universities located in Brazil's South, Northeast, and Central-West regions, such as UFPE (Northeast), UFC (Northeast), UFMG (Southeast), UFU (Southeast), UTFPR (South), and UFG (Central-West). This geographic diversity already offers a sample of the institutional landscape in different parts of the country. However, plans are underway to expand the application of the Science-Business Roadmap to researchers from additional universities—particularly in the Northern region—to ensure broader national representation and to understand regional variations in the scientific and technological innovation ecosystem.

5.3 Evaluation of Entrepreneurial Competencies

The identification and development of entrepreneurial competencies have already been highlighted as critical success factors in the entrepreneurial process of academic researchers, as noted in Coelho's doctoral thesis (2022), which investigated the trajectories of entrepreneurial professors at Brazilian public universities. That study found that the ability to combine scientific and entrepreneurial competencies was essential for enabling the creation of spin-offs, executing Research, Development, and Innovation (R&D&I) projects, and providing services in partnership with companies to facilitate the effective transfer of knowledge and technology. Thus, understanding how researchers perceive their entrepreneurial skills is a fundamental step toward improving tools such as SBR.

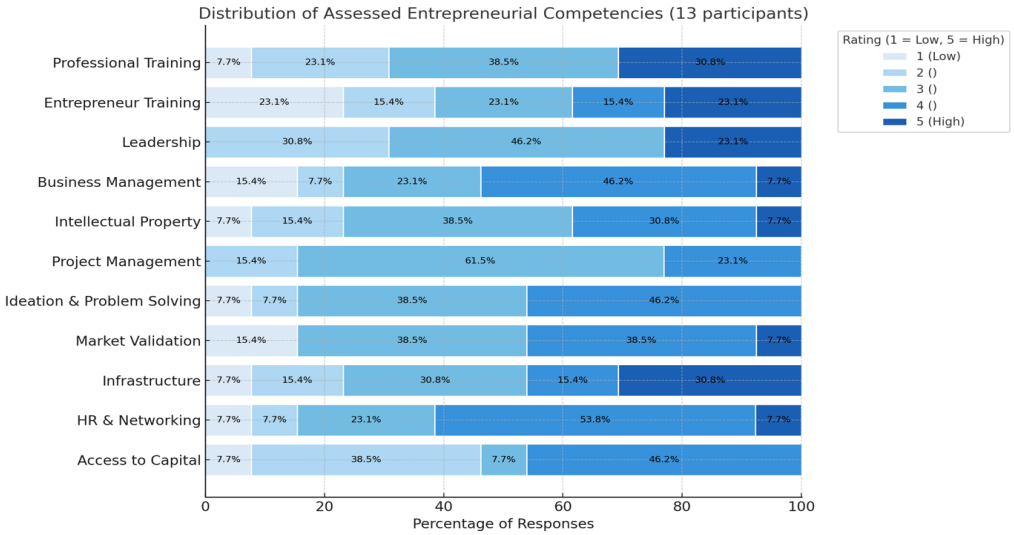


Figure 1: Distribution of Self-Assessed Entrepreneurial Competencies

Source: Authors' own elaboration, 2025.

Figure 1 presents the distribution of entrepreneurial competencies self-assessed by the participants based on their current projects or ventures. The analysis revealed relevant patterns regarding both strengths and gaps in the trajectories of researchers engaged in innovation. Among the competencies with the highest concentration of maximum scores (score 5 – "excellent knowledge and extensive practical experience"), the following stand out:

- **Project Management**: 23.1% assigned the maximum score, and 61.5% assigned score 4, indicating an advanced level of mastery of this competency.
- **Ideation and Problem Solving**: 46.2% assigned score 5, demonstrating high creative and analytical capacity.
- **Infrastructure**: 30.8% assigned score 5, and another 15.4% assigned score 4, reflecting partial access to resources and innovation environments.
- **Professional Training**: 30.8% assigned score 5, and 38.5% score 4, evidencing a strong academic background in training talent.

On the other hand, the competencies with the most perceived gaps were (considering score 1 as "little knowledge and little experience"):

- **Business Management**: Only 7.7% assigned score 5, while 15.4% assigned score 1, indicating weaknesses in administrative and strategic aspects.
- **Intellectual Property**: Only 7.7% assigned score 5, indicating challenges in protecting and managing generated knowledge.
- **Market Validation**: Also, with only 7.7% assigning the maximum score (5), highlighting difficulties in connecting science with real market demand.
- **Human Resources and Networking**: 7.7% assigned score 5, suggesting weaknesses in engaging with the innovation ecosystem.
- **Access to Capital**: No participant assigned the maximum score, and 7.7% assigned score 1, reinforcing the perception of barriers to financing.

These findings reinforce the importance of the SBR as a tool for developing key competencies in the scientist-entrepreneur journey. The current version of the SBR already addresses critical areas such as strategic management, fundraising, business modeling, and knowledge protection—several of which align with internationally validated competencies from the European Entrepreneurship Competence Framework (EntreComp) (Bacigalupo et al., 2016), such as resource mobilization, planning and management, and risk management. As a next step, future research will focus on incorporating and validating complementary competencies not yet covered, including creativity, strategic vision, ethical and sustainable thinking, self-awareness, self-efficacy, financial literacy, and teamwork. This integration aims to enhance the SBR's ability to

foster entrepreneurial mindsets and support the transformation of research into innovative businesses, while assessing the relevance and applicability of these competencies in the Brazilian context.

5.4 Perceptions of the SBR Format

Participants' receptiveness to SBR was broadly positive, accompanied by valuable suggestions for institutional adoption and improved user experience. Figures 2 and 3, used to support the question about the visualization and design of the tool, highlight participants' strong interest in visual models that clearly and structurally communicate the SBR content.



Figure 2: Timeline with strategies prioritized in the short term

Source: Authors' own elaboration, 2025.

Figure 2 illustrates a timeline of short-term prioritized strategies, exemplifying the visual journey of the researcher and forming the basis of SBR. Figure 3 presents the KTTRM framework, structured around temporal phases and strategic dimensions, developed in the doctoral thesis on the trajectories of successful entrepreneurial professors at Brazilian public universities (Coelho, 2022). It is a proposal for the prospective planning of the Scientist's Entrepreneurial Journey. Both visual representations can be integrated into the SBR tool to provide effective visualizations of this journey, contributing to user engagement and tracking of the development stages of scientific ventures.

When asked about their preferred format to visualize their entrepreneurial journey, 46.2% of respondents indicated a preference for "all the above visualizations," showing a desire for multiple forms of accessing information. The remaining responses were distributed among the framework format (46,2%), timeline format (23.1%), list of strategies (7.7%), and integration into a smart system (7.7%).

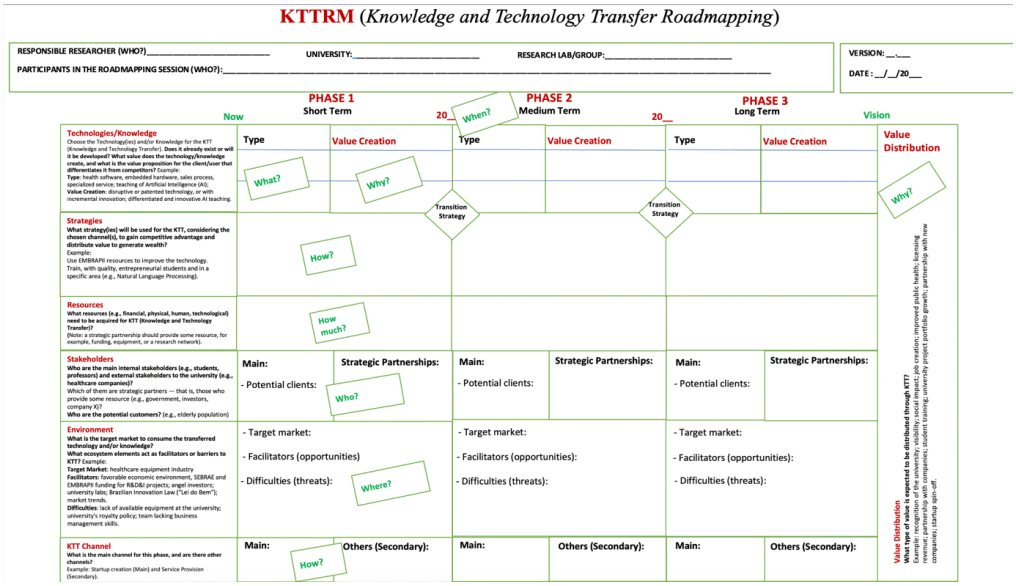


Figure 3: KTTRM (Knowledge and Technology Transfer Roadmap Methodology) Framework

Source: Adapted from Coelho (2022).

These preferences indicate that a combination of visual roadmap, interactive timeline, and personalized strategy list could enhance researchers' engagement with the tool. Additionally, they emphasize the importance of a user-friendly interface, smart alerts, and integration with communication channels such as WhatsApp and email, as suggested in the open comments.

5.5 Functional and Strategic Assessment of SBR: Perceptions and Improvement Proposals

In addition to the overall evaluation of the format and applicability of SBR, participants also answered a set of specific questions related to advanced features, ecosystem integration, and institutional use possibilities of the tool. The main findings, listed below, reinforce the robustness of the proposed model and its potential impact on strengthening scientific entrepreneurship:

Entrepreneurial journey planning: All participants (100%) consider that visualizing the roadmap in temporal phases (short, medium-term, and long-term) facilitates the planning of the entrepreneurial journey. Additionally, 92.3% of respondents expressed a clear intention to share the roadmap with their teams, highlighting its potential for collaborative use within research groups and innovation centers. Meanwhile, 7.7% responded "Maybe," indicating a cautious but open stance toward its collective adoption.

Use of artificial intelligence and personalization: All respondents (100%) positively evaluated the use of Artificial Intelligence (AI) in generating personalized roadmaps based on their responses, the current stage of their projects, and successful entrepreneurial cases of professors who created wealth (Coelho, 2022).

Integration with ecosystems and smart platforms: The integration of SBR with intelligent platforms was considered relevant by 100% of participants, especially for mapping funding calls, market opportunities, and technological demands. Moreover, 92.3% approved the feature of recommending people with shared interests (such as other researchers, mentors, and investors), reinforcing the SBR's potential as a connector for scientific and entrepreneurial collaboration networks. All participants also believe their institutions would be interested in accessing the aggregated data generated by the platform.

Institutional and governmental interest: Most respondents (92.3%) recognize that SBR can assist funding agencies in identifying and mapping scientific entrepreneurial profiles, strengthening public policies aimed at innovation and technological development. Only 30.8% of participants believe that funding agencies would cover the cost of structured access to the information generated by the tool. Another 61.5% responded "maybe," indicating a cautious openness to the possibility, while 7.7% do not believe this is viable. These findings suggest that there may indeed be interest in paying for the information produced by SBR; however, monetization will depend on demonstrating its value and effectively engaging with the relevant agencies. Regarding institutional acceptance, 92.3% believe the tool would be well received in their universities. Open responses reinforce the positive perception to BR adoption among universities, especially those with a technological profile and an innovation focus. One respondent noted: "Yes. Given UTFPR's profile as a technological university focused on delivering value to the market, the tool would certainly be widely used by the Pro-Rectory of Business Relations." Another participant added: "At my institution (UFU), there has been a recent advancement in the innovation ranking [...]. UFU's patent portfolio has grown significantly, and researchers' interest in innovation and entrepreneurship has also increased." These statements also highlight that successful adoption depends on the engagement of leadership and integration with innovation centers, as emphasized by a researcher from UFC: "I believe that the Science-Business Roadmap would not only be well accepted but also highly functional and strategic, especially if introduced by academic leaders with credibility."

Perceived value as a guiding tool: When asked about the potential of the SBR tool to guide their entrepreneurial journeys based on the best paths already taken by successful entrepreneurial researchers, 76.9% of participants responded positively. This data reinforces the perceived value of the tool as a strategic guide, capable of providing practical directions inspired by real cases to overcome recurring challenges in translating science into business. Another 23.1% responded "maybe," indicating openness to the proposal and signaling opportunities further to improve the experience and personalization of the SBR recommendations.

Monetization and sustainability potential: When asked about their willingness to pay a subscription to use the SBR tool, if it truly adds value to their entrepreneurial journey, 30.8% of participants fully agreed, and another 30.8% partially agreed, totaling 61.6% potential acceptance of the subscription model. Another 23.1% were indifferent, while 15.4% disagreed. These data indicate a relevant openness to monetizing the solution, especially if practical results in journey personalization and connection to real opportunities are demonstrated. This also signals the importance of exploring hybrid funding models, such as freemium versions, institutional support, or public subsidies.

Suggestions for Tool Improvement: Participants' suggestions highlight relevant pathways for improving SBR, emphasizing technological integration, usability, and practical applicability. One respondent proposed creating a "resource and opportunity radar linked to the researcher's WhatsApp or email," while another suggested developing a "tool website" to facilitate access. The importance of managing "multiple journeys simultaneously" and adopting metrics such as TRLs, Key Performance Indicators KPIs, Lean Canvas, and even alignment with the SDGs was also mentioned. One structured suggestion recommended that the tool "incorporate regulatory milestones, professional profiles by stage, and risk analysis, in addition to an interactive version with a repository of best practices and adaptation for use in institutional proposals such as PIBIC, CAPES, and CNPq."[1] These comments demonstrate the high level of engagement and critical thinking among participants, who recognize the value of SBR and propose improvements for its consolidation as a robust solution integrated into scientific and entrepreneurial culture.

User initial engagement: 84.6% expressed interest in participating in the pilot of the Minimum Viable Product (MVP) version of the tool free of charge.

These results provide strong validation of the SBR, reinforcing its potential as a practical and scalable solution to support scientist-entrepreneurs across multiple dimensions — from strategic planning to connecting with real opportunities and the innovation ecosystem, thereby turning science into business.

6. Conclusions

The preliminary validation of the SBR with researchers from different Brazilian public universities demonstrated its relevance as a support tool for the entrepreneurial journey within the academic context. The results indicate a widely positive reception of the tool, reinforcing the demand for solutions that structure the transition from science to market in a strategic and personalized way.

The SBR proved to be especially useful in the intermediate phases of technological development, assisting researchers in challenges such as business modeling, market validation, and fundraising. The analysis highlighted gaps in entrepreneurial competencies, underscoring the importance of digital tools that support developing these skills. In addition to contributing to the individual planning of scientist-entrepreneurs, SBR is consolidating itself as a solution with institutionalization potential, by supporting universities in mapping innovative profiles, integrating with ecosystems, and building stronger internal innovation policies. Its personalization, usability, and integration with external data strengthen its proposition as a strategic tool for entrepreneurial intelligence.

Therefore, although the tool is still undergoing validation and refinement at the Center for Informatics of UFPE, initial findings suggest that SBR has the potential to be consolidated as a strategic tool for the institutionalization of scientific entrepreneurship in Brazilian public universities. Its adoption can foster a culture of innovation, strengthen regional ecosystems, and support the development of academic leadership committed to technological transformation and sustainable development.

Ethics Statement

This research did not involve the collection of sensitive data or experiments involving human subjects and therefore did not require approval by a Research Ethics Committee.

[1] TRL: Technology Readiness Level; KPI: Key Performance Indicator; SDG: Sustainable Development Goal (United Nations 2030 Agenda); PIBIC: Institutional Program for Scientific Initiation Scholarships; CAPES: Coordination for the Improvement of Higher Education Personnel; CNPq: National Council for Scientific and Technological Development.

AI Use Disclosure

For this article, generative artificial intelligence tools were used exclusively to support the creation of graphic images with improved visual quality, based on data collected in the research. All textual content was developed by the authors based on their research experience and critical analysis of the results. The AI-generated images were reviewed and validated to ensure fidelity to the original data and the scientific purpose of the study.

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A Case Study on Bridging the Employment Gap: A Human-Centred Innovation for South Africa's Informal Job Sector

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Abstract: Unemployment in the informal job sector is a persistent social challenge, particularly for individuals with limited or no work experience in a country with one of the highest unemployment rates worldwide. Many job seekers struggle to access updated CV formats, trusted references, and direct employer connections, limiting their chance for employment. Addressing this issue requires an innovative, human-centred business approach that not only connects job seekers with employment opportunities but also fosters long-term social and economic impact. This paper explores iLink, a web-based application designed to bridge the gap between informal job seekers and employers. Unlike mainstream job-finding platforms, iLink is specifically tailored to serve the workforce in the informal sector by leveraging community input to build credible online profiles for job seekers. In South Africa, many domestic workers, gardeners, and nannies work without formal contracts, making them vulnerable to low wages, job insecurity, and limited legal protections. Through low-cost vetting processes and employer feedback mechanisms, iLink enhances job matching by ensuring that employers can find workers with verifiable skills and references. This paper examines how human-centred innovation can drive employment accessibility, improve workforce readiness, and contribute to economic inclusion in the informal job market.

Keywords: Social human-centred Business, Higher Education

1. Introduction

Unemployment is a pressing issue worldwide with statistics showing the effect on millions of unemployed individuals as in South Africa – a country with the highest unemployment rate worldwide (Statistics South Africa, 2024). Huge shifts in economics due to the COVID pandemic, effect of Artificial Intelligence (AI), globalisation and changing labour markers has impacted this phenomenon. Vulnerable communities are affected even more – especially youth, women and those in vulnerable sectors (Tóth et al., 2023).

Social entrepreneurship is a fundamental element to attempt to further social goals to elevate poverty and to develop the community. One such entrepreneurship project is iLink, a web-based application designed to bridge the gap between informal job seekers and employers. iLink is tailored to specifically serve the underserved informal job market within South Africa by levering community input in building credible online profiles for job seekers. Domestic workers, gardeners and nannies complete informal and formal short courses, but never gets "linked" with potential employers. iLink has the purpose and pursuit to assist the informal sector in ensuring that potential candidates are matched with potential employers by providing reliable workers with verifiable skills and references.

iLink was born from an entrepreneurship competition hosted by idea-GYM, an Idea Generator unit, resorting under the Innovation and Technology Transfer Office at a Higher Education Institute in South Africa that promotes business start-ups. The iLink social impact business was funded by the unit providing start-up costs for this human-centred innovation driving employment accessibility, improvement of workforce readiness, and contribute to economic inclusion in the informal job market and providing business training though the training program.

Within South Africa the informal sector plays a pivotal part in absorbing a large share of the unemployed citizens in South Africa, yet it remains unsupported.

2. Literature Review

South Africa continues to grapple with high levels of unemployment, especially amongst youth and the informal job sector who is often seen as low-skilled individuals. According to Statistics South Africa's Quarterly Labour Force Survey (2024), the unemployment rate exceeds 40%, of which the informal sector has a significant share in. Looking at unemployment within the social entrepreneurial sphere it is important to note that not all people who do not work can be seen as unemployed (International Monetary Fund, 2023).

In this context, social entrepreneurs have emerged as vital agents of change, developing community-driven solutions that offer training and employment pathways. Social entrepreneurship can in short be defined as the pursuit of sustainable solutions to neglected problems with positive externalities (Santos, 2012). Social Entrepreneurship is not a new theory, and early evidence can be found since the 1920's (Teasdale et al., 2022). With the growing need of entrepreneurial innovations that address issues that traditional business models or government interventions cannot effectively address, social entrepreneurship is gaining growing interest and popularity, one of these entrepreneurial innovations is to address the growing unemployment amongst the informal job sectors. However, the informal economy presents unique challenges in terms of accessibility and lack of technological advancements, which makes reaching this target market extremely time consuming. Often candidates who needs to be accessed is also illiterate with low levels of education.

iLink is a South African based social enterprise that was established in 2021. The start-up focuses on addressing unemployment in the informal sector, helping caretakers, domestic workers and gardeners to find employment. It connects employers seeking this type of informal labour market workers with vetted, trained, and reference-checked individuals, creating safer and more professional employment relationships. iLink also offers informal, low-cost training programs that culminate in certificates of completion.

Often social entrepreneurship programmes struggle to transition beyond pilot funding, due to limited outcome data and the difficulty of quantifying "soft" impacts such as confidence, community leadership, and informal learning (Desjardins & Rubenson, 2013).

Higher Education Institutions are starting to leverage institutional capacity to develop solutions beyond traditional academic outputs, this trend is emerging even stronger at Universities of Technologies. Education in innovation and entrepreneurship is now a focus within Universities of Technology, aiming to transform more graduates from job seekers into job creators (Central University of Technology, 2025). By establishing innovation hubs, such as the idea-Gym at the Central University of Technology and the Solution Space at the University of Cape Town (University of Cape Town, 2025), support and guidance is given to staff and students with innovative ideas to solve social problems by providing funding, mentorship, access to resources and networks as well as supporting these entrepreneurs to launch socially impactful enterprises.

The policy on Community Engagement at the CUT is based on an integration of the university with the community via the quadruple helix approach and social communities. The university's Vision 2023 Statement emphasizes social and technological innovations, socio-economic development with the aim of creating jobs (innovative and entrepreneurial spirit) and to be engaged with its communities. This directly aligns with the 2030 CUT vision statement "By 2030, Central University of Technology, Free State will be a leading African university of technology, shaping the future through innovation" (Central University of Technology, 2025b). By fostering and developing socially responsive business models by academia, staff and students, HEIs are creating an imprint and ripple effect of sustainable entrepreneurship, especially in underserved communities. Addressing these challenges requires multi-stakeholder collaboration and systemic support, including enabling policies, accessible funding, and partnerships that acknowledge the informal sector's critical role in South Africa's economy.

2.1 Comparative Programmes to Ilink

Looking at different social interventions formats is useful to assess the impact and scope of a social intervention. Broadly this study looked at the objectives, target groups, delivery methods, and outcomes of the following programmes:

The above comparative analysis of employment-focused programmes available in South Africa highlights various approaches to improve employability, initiatives included are mostly of focussed on the informal and youth sector workers. Examining programmes like the Shoprite Retail Readiness Programme (RRP) and YES Initiative who offer structured, large-scale work-integrated learning and successfully showed tangible employment outcomes by placing over 38,000 youth since 2016 and international models like the ILO Apprenticeship Reskilling Programme and Europe's EEPO initiatives that emphasize lifelong learning, targeted upskilling, and systematic labour market integration Youth Employment Service, 2024; Shoprite Group, 2024; International Labour Organization, 2023; University of Cape Town Graduate School of Business, 2025; European Employment Policy Observatory, 2024). In contrast, iLink presents a micro-level, community-driven model that is focused on informal job seekers who are often excluded from larger scale systems due to their limited literacy, lack of formal credentials and digital exclusion.

iLink's distinguishing factor is the element that it is hyper-local, human centred and leverages the trust of the community, adaptability and the low barrier entry. While there are various comparative programmes focusing on formal sector readiness or rely on large scale government or corporate infrastructure, iLink addresses gaps that the traditional, bigger employment frameworks tend to overlook, offering a promising alternative model for employment generation. The web-based application is specifically designed to bridge the gap between informal job seekers and employers by leveraging community input to build credible online profiles.

3. Methodologic Approach & Results

In this explanatory case study, a semi-structured interview was conducted with the entrepreneur to gain insight regarding the objectives & outcomes of the start-up and how challenges were addressed. What role did the entrepreneurship training program offered and which aspect of the training proof to be valuable, which aspects could be added or improved on was done with feedback surveys pre- & post-training. The aim was to provide and gain insights that are specific to the case for practical implementation in other similar initiatives and improving on structure of an entrepreneurial development program.

Entrepreneurship is a key driver of innovation, economies' diversification and inclusive growth, particularly in the emerging economies such as South Africa. In response to the growing necessity for systematic entrepreneurial training, the Entrepreneurial Development Programme (EDP) offered at the Idea Generator Unit was developed as an official educational intervention to offer prospective entrepreneurs basic business information as well as applied competencies. The EDP is designed as an outcomes-based, modular program that integrates key elements of the entrepreneurial processes, consisting of series of workshops. This annual program stated in 2020 is adapted yearly based on participators' feedback.

Milestones listing required for presentation in the challenge to obtain funding and adjustment made post-startup implementation is listed as results in Table 2.

Table 2: iLink – Milestones, Results, Decision Criteria, Deliverables, Key Activities

Mile-stones	Pre-Startup Planning	Post-Startup results	Decision Criteria	Deliverables & Key Activities
1	1.1 Identify reliable web developer 1.2 Register as a PTY LTD 1.3 Draft legal contract with developer	1.1 Website self-developed after research 1.2 Registration changed to NPO/Trust after consultation 1.3 Legal documentation completed	1.1 Developer identified within budget and capable 1.2 PTY LTD registration completed 1.3 Signed legal agreement in place	Signed legal contract Initial registration documents & Self-development of website Legal contracting
2	2.1 Register domain: www.ilink.org.za 2.2 Develop website prototype 2.3 Identify and secure strategic partnerships	2.1 Domain established: ilink.godaddysites.com 2.2 Prototype developed and tested 2.3 Partnership secured with Department of Labour and Employment	2.1 Domain registration completed 2.2 Prototype presented and functional 2.3 Signed agreements with partners holding work seeker databases	Registered domain Working website prototype Confirmed partnerships & Domain registration Prototype refinement Partner engagement
3	3.1 Test website with work seekers 3.2 Test website with employers 3.3 Begin marketing	3.1 Tested with sample group of work seekers 3.2 Tested with sample group of employers 3.3 Website promoted on social media and local platforms	3.1 Website functional for work seekers 3.2 Employers validate usability 3.3 Growing public engagement	Functioning platform User validation (employees/employers) Marketing reach Stakeholder testing Marketing development Public launch

3.1 Pre- and Post- Training Survey

Indicate level of knowledge for the following topics (Scale: Well Informed (5); Knowledgeable (4); Some Knowledge (3) Limited Knowledge (2); No Knowledge (1))

Table 3: Pre – Post- Training Survey

Workshop Topics	Pre-Training	Post-Training
Creativity & Innovation	5	5
Feasibility & Viability	3	5
Target Marketing	4	5
Relationship Marketing	4	4
SME Business Management	4	5
Operations, Logistics and Purchasing Management	3	4
Management	5	5
Legal Aspects of a Business	3	5
Project Management	3	5
Business Canvas Model	2	4

3.2 Interview Analysis

What began as an individual response to a personal need, soon snowballed into a business idea and broader intervention started in 2022 after receiving funding through winning prize money at a competition hosted by the Idea Generator unit at the end of 2021, to address unemployment and economic exclusion through direct community engagement and grassroot marketing. It draws strength from its emphasis on trust, personal service, and context-specific solutions for an underserved target market.

Traditional marketing approaches such as social media were found to be ineffective for the intended user group, lacking internet access or digital literacy. This insight informed a blended approach combining printed materials, SMS communication, and in-person recruitment—often supported by students gaining work-integrated learning experience. A strong sense of social responsibility underpins the operation, with a focus on enabling job seekers not only to find employment but also to improve their employability through practical training, CV building, and basic digital skills development.

Despite limited funding and resources, the initiative continues to grow by leveraging community networks, partnerships, and an adaptive mindset. Balancing full-time employment, academic studies, and business development presented ongoing challenges, yet careful planning and emotional self-regulation helped sustain momentum.

The venture reflects an iterative, non-linear approach to entrepreneurship where small adjustments in one area often create ripple effects across the system. Through commitment to follow-through, responsiveness to emerging needs, and the prioritisation of meaningful impact over rapid scaling, the enterprise offers a grounded model of socially conscious entrepreneurship within South Africa's informal economy.

3.3 Observations at iLink Business: Factors Influencing the Outcome of the Implementation Process and Adaptation to Succeed and Value of the EDP Training Program

The business idea demonstrates originality, requiring minimal physical infrastructure but reliant on mobility and digital facilitation. Through the EDP, the participant reported gaining critical entrepreneurial skills, particularly in financial planning, business model development, and marketing strategy. This knowledge empowered greater confidence in transitioning from concept to implementation. The respondent highlighted the importance of practical guidance provided by the programme, particularly regarding business processes, milestone mapping, and awareness of common pitfalls—knowledge areas seen as instrumental for start-up survival in the informal economy.

The post-survey reinforced the programme's relevance, with self-reported knowledge across a broad range of topics. A notable shift observed in the depth of reflection regarding long-term business needs, with future expectations centred on funding access, mentorship, regulatory compliance, and sustainable business practices. This suggests that the EDP not only delivered foundational knowledge but also fostered forward-thinking and strategic awareness. Additionally, the preference for visionary thinking, creativity, and self-discipline as core entrepreneurial traits aligns with the business model's emphasis on innovation and problem-solving in low-resource environments.

The experience revealed a continued need for contextualised support, such as training on customer engagement, negotiation, and digital marketing optimisation - elements that align closely with the operational challenges identified in earlier interview data. The programme's perceived impact was strengthened by its emphasis on community-building and peer learning, with the participant valuing the opportunity to network with like-minded entrepreneurs. Overall, the EDP functioned as both a knowledge-building platform and a motivational catalyst, reinforcing entrepreneurial intent while equipping participants to pursue inclusive, socially impactful business models.

4. Discussion

The structured learning sessions of the entrepreneurial development program influenced the implementation of iLink which serves as a platform to minimize employment gaps in the South African informal job sector. The start-up used the Business Canvas Model framework as a foundation to create essential business concept elements. The platform's value proposition and distribution channels were defined through this process while also identifying customer segments and cost structure. The company also implemented early project milestones regarding legal structuring and technical development with full comprehension of the business model's foundational principles. The feasibility analysis module intensified the entrepreneur's understanding by requiring them to validate core assumptions through practical testing. The realistic evaluation of financial and technical restrictions led to the internal development of the website since it demonstrated the project's transition from visionary thinking to practical implementation.

The focus on competitor analysis and creativity showed the entrepreneur's efforts to differentiate iLink from competitors. Rather than to directly compete with bigger formal job seeking applications, iLink used a context specific tool, tailored to the specific market – namely informal jobseekers. Furthermore, the environmental analysis component provided the entrepreneur with tools for assessing and adapting to socio-economic and technological conditions of their target market, which increased the platform's success. These insights are in turn directly influenced by marketing strategies, looking at the focus on grassroot-level outreach and the use of community centres and churches for user acquisition.

Principles of the management model are reflected in the structured milestone framework in the way tasks are allocated and iterative reporting mechanisms. Financial Management training further reinforced the project's sustainability in the form of budget conscious decisions, such as developing the platform in-house and leveraging the community for marketing rather than expensive marketing strategies and tools. This enabled the project to hold momentum despite possible resource limitations.

The iLink platform clearly demonstrates how applied entrepreneurial education can significantly influence the trajectory of social innovation. There can be clear lines drawn between the integration of key entrepreneurial themes to the project milestones that are set out. The EDP programme did not only provide technical tools but also cultivated an adaptive, resilient mindset in the entrepreneur that proved essential for developing a practical and contextually grounded solution for unemployment in the informal sector in South Africa.

The human approach to employment in South Africa aligns strongly with this case study. Several key points emerged that reinforce both the value and the complexity of addressing unemployment in the context of social entrepreneurship. One of the core strengths is the responsiveness to local needs.

When applying iLink through the lens of post-project reflection, core strengths such as community trust, relevance and creativity stand out, while gaps such as 1. progression pathways, 2. system integration and 3. duplication on a larger scale can be seen as weaknesses. For instance, the lack of administrative personnel is a limitation for iLink to properly provide services to potential clients. This reflective practice gives a guideline to design more responsive programs and builds the capacity of practitioners to learn alongside their participants—a hallmark of effective social entrepreneurship. The importance of building meaningful relationships with local communities was done by these four elements 1. building trust though consistency, 2. presence, 3. adaptability

and 4. culturally sensitive facilitation. These insights reflect broader findings in adult education literature (Merriam, 2001; Rubenson & Desjardins, 2009), which emphasise the emotional and social dimensions of learning.

Building meaningful relationships and development of the rural communities in the form of upskilling the informal labour force are the two of the core elements implemented by iLink and furthermore the social entrepreneur served not only as a facilitator of training but also as a connector, counsellor, and informal advocate.

This multidimensional responsibility underscores the complexity of work in marginalised spaces, where entrepreneurs must navigate between the needs of the community, financing of the enterprise and restricted resources. While the intervention achieved success in short-term skill development and confidence-building, sustaining impact remains a challenge and a limitation. These concerns echo the question around preventing dependency and designing interventions that enables the informal work seekers to become self-sustaining as sustainable development and employment is core functions of this social enterprise. The intervention was successful at a localised level however the absence of integrated support can hinder long-term employment gains.

5. Conclusion

This explanatory case study set out to explore how a human-centred, socially entrepreneurial innovation can address the persistent employment gap in South Africa's informal job sector. Rooted in empathy, responsiveness, and community trust, the project demonstrated that innovation designed with and for the people it serves can create immediate impact in contexts often overlooked by mainstream employment platforms.

The financial and support in from the idea-GYM unit dedicated to support entrepreneurship and innovation at the higher education institute was pivotal. It enabled the transformation of a seed idea into a functional, socially impactful business with measurable reach. Milestones such as the onboarding of the first 100 job seekers, development of digital profiles, employer-user engagement, and job matches served as practical indicators of early success. The business model proved viable in its pilot phase, but it remains sensitive to scale-related challenges, such as platform maintenance, community onboarding, and user support and funding for full time employees to upscale and increase output and linking of employers to job seekers.

From a sustainability perspective, iLink's most significant contribution lies in fostering self-reliance, skills recognition, and economic inclusion. It offers a promising example of how human-centred business models can respond to systemic employment challenges in marginalised contexts. It calls on higher education institutions, funders, and social entrepreneurs to jointly invest in scalable, context-sensitive employment solutions. By integrating technology with trust, and innovation with inclusion, it charts a path forward in creating sustainable livelihoods for those most in need.

6. Recommendations

Social Entrepreneurship programmes should be integrated in training programmes offered at Higher Education institutions and institutional support should be given for continued expansion of their role to foster social entrepreneurship by providing incubation, mentorship, and entrepreneurial development programs. Additional courses on Artificial Intelligence and Human Capital might become essential in the changing landscape of social entrepreneurship.

Despite the successes of this social entrepreneurship, long-term sustainability remains contingent on several factors since access to basic resources such as mobile data, transportation, and reliable communication tools for job seekers remains a big barrier. Continued support and funding to move beyond the pilot and integrate broader digital infrastructure will be needed.

Looking at the limited digital access and literacy amongst the target population, future social entrepreneurship ventures within this scope might look at a hybrid outreach approach by combining low and digital platforms. Investment in user friendly technology infrastructure might also be critical for scaling social interventions without compromising the core or accessibility.

By integrating social entrepreneurship into higher education, support is essential for a sustainable impact.

Ethical Declaration

Ethical clearance was not needing for this research.

AI Declaration

AI was not used in this study

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Age in the Nascent Entrepreneurial Stage: A Multi-Level Analysis Approach

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Abstract: This study investigates the role of age in the entrepreneurial landscape, moving beyond the traditional focus on individual founder age to examine how age diversity within newly formed entrepreneurial teams (ETs) is associated with launching new products or services. To provide a theoretical foundation, we integrate two primary frameworks. First, the information/decision-making model, coupled with social capital theory, is employed to elucidate the mechanisms through which age diversity within nascent ETs can facilitate successful market entry. Second, the study draws upon life span theory to examine the relationship between the nascent ET leader's age and the transition from entrepreneurial intention to actual exploitation. While age can positively moderate the intention-to-exploitation transition, it may also have negative effects on opportunity identification and overall entrepreneurial activity. This study proposes that the accumulated experience, established networks, and greater strategic patience associated with increasing age in nascent ET leaders can be beneficial in navigating the inherent complexities and uncertainties of launching a new venture. By focusing on the nascent stage of entrepreneurship, this research offers a more granular understanding of how age dynamics at both the team and leadership levels influence the fundamental process of transforming entrepreneurial ideas into tangible market offerings.

Keywords: Entrepreneurial Teams, Age Diversity, Entrepreneurial Success, Business Plan Competition, Mediation Analysis

1. Introduction

The increasing prevalence of aging populations across continents (Cucculelli et al., 2023; Lévesque & Minniti, 2011) has fueled research interest in the role of age in entrepreneurship (Brieger et al., 2021; Mensmann & Zacher, 2020). This growing body of work has led to empirical and theoretical advancements in understanding the relationship between age and entrepreneurial behavior across the lifespan, linking age to various entrepreneurial outcomes such as venture growth (Matthews et al., 2024), survival rates (Robb et al., 2010), and firm size (Zhao et al., 2021).

While prior research has largely focused on the age of individual entrepreneurs, a recent meta-analysis highlights the necessity of shifting the focus to the age composition of entrepreneurial teams (ETs) to further advance our understanding of age in entrepreneurship (Zhao et al., 2021). Responding to this call, this study aims to contribute to the age-entrepreneurial outcome literature by investigating age diversity within nascent ETs.

Despite the significant influence of ETs on new venture development, research indicates the crucial role of team leaders in their effectiveness (Siren et al., 2020), suggesting an important interplay between the team and its leadership. Building on these insights, we examine the role of age diversity in nascent ETs, the age of their leaders, and the interaction between these two levels. Furthermore, this study examines the role of ETs' age diversity during the early entrepreneurial stage because events occurring in this phase of the entrepreneurial journey have long-lasting implications for the entrepreneurial process (Davidsson & Honig, 2003; Wickstrøm et al., 2022).

Our research is grounded in two primary theoretical frameworks. First, we integrate the information/decision-making model (Hackman, 1978) and social capital theory (Lin et al., 1981) to explain how age diversity in nascent ETs facilitates the launch of new products or services. The information/decision-making approach suggests that diverse teams bring a wider range of perspectives and knowledge, which can be advantageous in the ambiguous environment of nascent entrepreneurship (Ireland et al., 2003). Complementarily, social capital theory posits that access to external resources is crucial for resource-constrained nascent ventures, and age diversity can enhance this access (Evald et al., 2006). Second, we draw upon life span theory (Baltes, 1987) to theorize about the relationship between nascent ET leaders' age and the transition from entrepreneurial intention to exploitation. Life span theory proposes that individuals experience both gains and losses with age, offering a lens to understand the multifaceted impact of age on entrepreneurial activities. Prior research has indicated that age can positively moderate the intention-to-exploitation transition (Gielnik et al., 2018) while also having

negative effects on opportunity identification and entrepreneurial activity (Bohlmann et al., 2017). We posit that with increasing age, nascent ET leaders' accumulated experience and networks become particularly beneficial in navigating the complexities of launching a new venture.

Our study seeks to contribute to the literature on age in entrepreneurship in several key ways. First, we investigate age diversity within entrepreneurial teams (ETs) at the nascent stage. Second, while focusing on ET age, we also incorporate the individual level by examining the age of team leaders. Third, we specifically expand existing research to the crucial nascent entrepreneurial stage. By investigating the combined effect of nascent ETs' age diversity and their leaders' age on transforming ideas into successful product or service launches, we contribute to the aging entrepreneurship literature by focusing on this fundamental transition (Choi & Shepherd, 2004).

2. Literature Review and Hypotheses

To investigate the influence of entrepreneurial teams' diversity on team and new venture outcomes, entrepreneurship scholars have extensively relied on two primary perspectives: social categorization and the information/decision-making process (Klotz et al., 2014). From a social categorization perspective, individuals tend to categorize others into in-groups or out-groups based on readily apparent attributes such as age, sex, or race. The potential for a negative relationship between ETs' age diversity and venture outcomes has been supported by this theory, suggesting that age diversity can foster interpersonal conflict and reduce cohesion among team members, thereby hindering new venture success. Conversely, the information/decision-making approach posits that age diversity can benefit teams by enriching task-related information processing through the exchange of diverse knowledge and perspectives (Van Knippenberg et al., 2004), ultimately enhancing ET effectiveness (Foo, 2011).

Entrepreneurial teams exhibit unique characteristics in their formation, composition, and dynamics, which can shape the impact of age diversity on opportunity exploitation. ETs typically emerge either through a leader recruiting members around an initial idea or through a group of individuals jointly initiating a startup (Shah et al., 2019). Calder-Wang et al. (2021) demonstrated that the impact of team diversity varies with its formation, with endogenous diversity mitigating some of the underperformance associated with forced diversity.

Considering the endogenous formation of ETs (Lazar et al., 2020) and the typically complex and creative tasks involved in nascent entrepreneurship (Bryant, 2004), we argue that ETs' age diversity will positively influence the transition from entrepreneurial intention to action, specifically the successful exploitation of opportunities.

> *Hypothesis 1: Age diversity within nascent entrepreneurial teams will be positively related to successful opportunity exploitation.*

The social capital theory pertains to the ability of individuals to gain an advantage from their networks and social systems (Lin et al., 1981). From an entrepreneurial standpoint, social capital provides networks that promote the discovery, identification, and exploitation of opportunities (Boudreaux et al., 2025). Several entrepreneurship scholars have relied on social capital theory to emphasize the role of external resources, relations, and ties on entrepreneurial outcomes (e.g., Alomani et al., 2021; Devarakonda et al., 2022).

We consider the entrepreneurial team's social capital as the external support that the team can access through its connections with banks, incubators, venture capitalists, universities, and external advisors. As new ventures generally have limited resources and lack a business history and track record, the entrepreneurial team's social capital plays a crucial role in mobilizing resources and building legitimacy for their new ventures (Gray et al., 2024a). In reference to opportunity exploitation, social capital can provide access to formal sources of funding (Lin, 2001), which can help in launching new venture products or service offerings (Butticè et al., 2017). In the nascent stage, the social capital derived from being embedded in a network positively affects the progress in launching a new venture (De Carolis et al., 2009). Similarly, social capital provides considerable resources when appropriately leveraged by nascent entrepreneurs, and it is significantly important for building a new venture (Alomani et al., 2021). Accordingly, we propose the following hypothesis:

> *Hypothesis 2: The social capital of a nascent entrepreneurial team will be positively related to successful opportunity exploitation.*

Building on the logic of the above hypotheses, we argue that the social capital represented in the knowledge and resources support will mediate the relationship between nascent ETs teams' age diversity and successful opportunity exploitation. Age diversity in nascent entrepreneurial team accelerates the injection of external

resources. The increase in social capital (i.e., external advisors, venture capitalists, banks, and others), in turn, enhances the success of entrepreneurial teams. Unlike other teams in established firm settings, self-selection involvement makes the interpersonal chemistry less problematic (Lazar et al., 2020). Under this condition, age diversity encourages the exchange of a wide variety of ideas (Tihanyi et al., 2000), leading to higher ET effectiveness (Foo, 2011). Such an attribute would encourage external support as early-stage inventors believe that founding teams are vital to entrepreneurial success (Gompers et al., 2016). Taken together, age-diverse ETs may have different perspectives on problems and opportunities, which can boost their creativity and innovation and thus increase their attractiveness to external support providers. Based on this reasoning, we hypothesize the following mediating relationship:

> *Hypothesis 3: The social capital of the entrepreneurial team will mediate the positive relationship between age diversity within the team and successful opportunity exploitation. Specifically, greater age diversity will lead to higher levels of social capital, which will then be positively associated with successful opportunity exploitation.*

We rely on the lifespan theory (Baltes, 1987) to hypothesize that nascent entrepreneurial team leaders' age positively relates to the transition from entrepreneurial intention to exploitation. The lifespan perspective posits that adult development involves four key aspects: loss, growth, reorganization, and exchange. Among these, loss and growth have received the most scholarly attention (Zhao et al., 2021). Accordingly, an individual's age can be viewed as a process of both losses and gains. The loss pattern is associated with fluid intelligence, which encompasses mental abilities such as work motivation, abstract thinking, functional memory, and information processing, and tends to decline with age. Conversely, crystallized intelligence, which refers to skills and knowledge acquired through experience and focused learning in a specific domain, typically increases with age and can compensate for the decrease in fluid intelligence (Kibler et al., 2024). We build on the premise that in the entrepreneurial context, the gains associated with older individuals often outweigh the losses, thereby supporting their efforts in translating ideas into viable businesses (Wickstrøm et al., 2022).

In the entrepreneurial context, the increase in crystallized intelligence has been linked to entrepreneurs' accumulated human capital. It is generally accepted that older individuals possess a greater reservoir of human capital, which should be advantageous for launching a new venture (Weber & Schaper, 2004). A successful transition from entrepreneurial intention to action necessitates specific skills, competencies, and knowledge (Baron, 2007).

Another crucial aspect of older entrepreneurs is the accumulated working and entrepreneurial experience they gain throughout their careers. Empirical evidence indicates that general work experience (Davidsson & Honig, 2003) and, more specifically, entrepreneurial experience (Chatterjee et al., 2022) have a positive impact on the early stages of entrepreneurship. Similarly, entrepreneurial experience has been shown to increase the probability of transitioning from entrepreneurial intention to action (Gielnik et al., 2018). Based on this theoretical framework, we hypothesize the following:

> *Hypothesis 4: The age of the entrepreneurial team leader will be positively associated with the successful launch of the nascent venture's products or services, as indicated by the occurrence of the first sale.*

Building upon our earlier argument that age diversity within entrepreneurial teams can positively influence opportunity exploitation by bringing a wider range of perspectives and resources, we now consider the role of the team leader's age in this relationship. We propose that the experience and accumulated wisdom often associated with older leaders may enhance a team's ability to leverage the diverse viewpoints arising from age heterogeneity. As entrepreneurs age, their well-being tends to improve because accumulated experience and wisdom help them navigate entrepreneurial activities more confidently and with less emotional exhaustion (Kibler et al., 2024). Older leaders possess superior conflict resolution skills, strategic thinking, and broader networks that can facilitate the synthesis of diverse ideas and the effective pursuit of opportunities (Fousiani et al., 2025). Therefore, we expect that the positive effects of age diversity will be more pronounced under the guidance of an older team leader. Based on this reasoning, we hypothesize the following complementary effect:

> *Hypothesis 5a: The effect of nascent ETs' age diversity on the likelihood of achieving first sale complements rather than substitutes for the effect of team leader age.*

We contend that the extent to which nascent ETs' age diversity and the leader's age influence the exploitation of entrepreneurial opportunity differs. While a nascent ET requires a leader to provide direction and facilitate progress, the unique contributions and collective resources of the team members are likely to be particularly

influential in the uncertain early phases of a new venture. Although the leader's knowledge and the team's shared understanding are valuable, the diverse perspectives, skills, and networks inherent in an age-diverse team can provide a broader range of solutions and approaches crucial for navigating the initial challenges of opportunity exploitation. This perspective underscores that the collective capabilities and dynamism of the entrepreneurial team form the core engine of a new venture's early success. We argue that the breadth of knowledge, experiences, and problem-solving approaches fostered by age diversity within the team will be a more critical driver for achieving the first sale compared to the individual characteristics of the leader, including their age.

> *Hypothesis 5b: The magnitude of the relationship between age heterogeneity within nascent entrepreneurial teams and the occurrence of the first sale will be greater than the magnitude of the relationship between the age of the team leader and the occurrence of the first sale.*

3. Setting and Variables

The research sample of this study comprises nascent ETs that participated in a business plan competition (BPC) organized by the local Chambers of Commerce, industrial associations, bank foundations, and universities located in the province of Rimini, Italy, and the Republic of San Marino. Teams with an entrepreneurial business idea and a written business plan report can freely participate and leave the competition with no monetary charge. We believe this flexibility is essential as the remaining teams present the highest level of commitment, as is the case in any nascent entrepreneurship phase. Also, teams who have established a new venture that has not existed for any longer than 12 months can participate in the competition as long as their venture is still in the process of realizing their first sale and has not yet yielded cash flow.

To capture the successful exploitation of entrepreneurial opportunity, we checked if nascent ETs participating in the business competition have succeeded in translating their entrepreneurial ideas and launching their product or service offerings. We coded the variable FIRST SALE equal to 1 if the nascent ET succeeded in achieving a first sale and 0 otherwise.

The study includes two main independent variables: TEAM AGE DIVERSITY and TEAM LEADER AGE. W*e* measure TEAM AGE DIVERSITY as the coefficient of variation or disparity index. The variable TEAM LEADER AGE measures age from the date of birth until the date of participation in the business plan competition.

To measure external support, we relied on the entire written business plan reports of the startups. Startups had to submit a written business plan with detailed information about their activities and team members. We coded the variable EXTERNAL SUPPORT by reading the business plan. Accordingly, it was noticed that the teams received external support in various ways.

At the team level, we control for education level and EDUCATION DIVERSITY by relying on Blau's index (1977). Besides, we factor into the model the variable FEMALE SHARE, which measures the proportion of female members in the team. Team size is another factor that can affect the early entrepreneurial stages. Lastly, we include the variable *TEAM EDUCATION ATTAINMENT, which is measured in years, from primary to doctoral studies.*

At the team leaders' level, we control the managerial and entrepreneurial experience. To classify the entrepreneurial and managerial experience of team leaders, we factor into the model a dummy variable that equals 1 if the team leader has been involved in any managerial position and 0 otherwise.

At the startup level, we include a dummy variable that takes on the value 1 if the entrepreneurial idea pertains to a service sector and 0 if it targets a manufacturing industry.

4. Results

To test our hypotheses, we used a binary logistic regression (logit) with a multi-step analysis of the main and combined effects and indirect effects of nascent ETs and teal leader age on the likelihood of successful opportunity exploitation, which is a dichotomous variable. Table 1 shows the results of the analysis in which the mediator (EXTERNAL SUPPORT) is regressed on the independent and control variables. Table 2 shows the results of the analysis in which the dependent variable is regressed on the independent variables and the mediator.

In Table 2, models 2 and 3, we test our main independent variables. Results reported under model 2 indicate that an increase in TEAM AGE DIVERSITY (b=0.42, $P < 0.1$) is positively correlated with a higher likelihood of startups

achieving a first sale. Such a positive relationship is observed also in model 3 (b=0.594, p < 0.05), after the inclusion of the variable TEAM LEADER AGE. Hence, the foregoing piece of evidence supports hypothesis 1.

Table 1: Logit model: External support

	(Model 1)	(Model 2)
Variables	**External support**	**External support**
Leader entrepreneurial experience	0.188**	0.165*
	(0.0815)	(0.0856)
Leader managerial experience	-0.105	-0.0973
	(0.0886)	(0.0885)
Team years of education	0.0143	0.0144
	(0.0161)	(0.0160)
Type of industry	0.0348	0.0202
	(0.0778)	(0.0776)
Female shares	-0.259**	-0.280**
	(0.110)	(0.113)
Educational diversity	-0.104	-0.139
	(0.118)	(0.124)
Experience diversity	-0.0340	-0.125
	(0.141)	(0.148)
Team age average	-0.00201	-0.00890
	(0.00379)	(0.00556)
team size	0.239*	0.241**
	(0.123)	(0.121)
Team Age diversity		0.492**
		(0.245)
Team Leader age		0.00559
		(0.00494)
Observations	166	166

**** p<0.01, ** p<0.05, * p<0.1*

To establish the mechanism that underlines how age diversity affects early entrepreneurial outcomes, the following conditions must hold: First, the independent variable *TEAM AGE DIVERSITY* must correlate with the mediator *EXTERNAL SUPPORT* in the first equation. Values reported under model 2 in Table 1 show that a change in TEAM AGE DIVERSITY is positively associated with an increase in the likelihood of receiving external support (b=0.48, P < 0.05). Second, the independent variable must correlate with the dependent variable in the second equation; in Table 2, models 2 and 3 point out a significant relationship between TEAM AGE DIVERSITY and the dependent variable, FIRST SALE. Third, the mediator *EXTERNAL SUPPORT* must be associated with the dependent variable FIRST SALE: this condition is met as shown by results under model 4 in Table 2: the estimated marginal effect is positive and significant (0.27, p<0.01). Lastly, after checking all the previous conditions, the effect of TEAM AGE DIVERSITY must decrease in model 4 to ensure that the mediated relationship is present. After introducing the variable EXTERNAL SUPPORT in model 4, we observe a decrease in the estimated effect of TEAM AGE DIVERSITY on the dependent variable from 0.58 (p < 0.05) to 0.43 (p < 0.1). The proceedings support hypotheses 2 and 3.

Table 2: Logit model predicting the likelihood of successful opportunity exploitation

Variables	(Model 1) First-sale	(Model 2) First-sale	(Model 3) First-sale	(Model 4) First-sale
Leader entrepreneurial experience	-0.197*	-0.191*	-0.239**	-0.319***
	(0.112)	(0.108)	(0.115)	(0.105)
Leader managerial experience	-0.0775	-0.0694	-0.0691	-0.0349
	(0.0922)	(0.0910)	(0.0886)	(0.0917)
Team years of education	0.0203	0.0204	0.0225	0.0173
	(0.0191)	(0.0195)	(0.0194)	(0.0185)
Type of industry	-0.0812	-0.0949	-0.0951	-0.108
	(0.0974)	(0.0986)	(0.0976)	(0.0912)
Female shares	-0.268**	-0.259**	-0.297**	-0.182
	(0.129)	(0.128)	(0.133)	(0.130)
Education diversity	-0.107	-0.146	-0.155	-0.133
	(0.148)	(0.148)	(0.143)	(0.138)
Experience diversity	-0.120	-0.177	-0.210	-0.184
	(0.156)	(0.160)	(0.157)	(0.149)
Team age average	0.00613	0.00367	-0.00426	-0.00137
	(0.00439)	(0.00452)	(0.00600)	(0.00579)
team size	0.302**	0.316**	0.301**	0.233*
	(0.141)	(0.144)	(0.141)	(0.137)
Team Age diversity		0.425*	0.594**	0.441*
		(0.259)	(0.269)	(0.252)
Team Leader age			0.00977*	0.00756
			(0.00515)	(0.00475)
External support				0.287***
				(0.0579)
Observations	166	166	166	166

**** p<0.01, ** p<0.05, * p<0.1*

In *hypothesis 4,* we conjecture *that the age of nascent entrepreneurial teams' leaders is positively correlated with the successful exploitation of entrepreneurial opportunities. Results reported under Model 3 in Table 2 support this hypothesis (b=0.008, P < 0.1).*

The results shown under model 3 in Table 2 indicate that after the inclusion of TEAM LEADER AGE*, the effect of nascent ET age diversity on successful opportunity exploitation increases from 0.42 (p < 0.1)* to 0.594 *(p < 0.05).* Furthermore, the marginal effect associated with TEAM AGE DIVERSITY is higher than the one computed for TEAM LEADER AGE (*b*=0.008, *P* < 0.1). This piece of evidence lends support to hypotheses 5a and 5b.

5. Discussion

Given the relative dearth of knowledge about age in entrepreneurship (Mensmann & Zacher, 2020, Zhao et al., 2021), this study's main aim was to unpack the relationship between age and entrepreneurship across different levels of analysis. We specifically concentrated on nascent entrepreneurial teams (ETs) attempting to launch their products or services. To explain how age diversity can affect this early entrepreneurial outcome, we also incorporated the role of social capital within ETs, represented by external support from incubators, universities, venture capitalists, advisors, and banks. Our goal was to provide a holistic view of age's impact on the likelihood of achieving a first economic transaction by considering the main actors in startups.

Our findings highlight that nascent ET age diversity is crucial for the early success of startups. We found that age diversity can directly enhance early outcomes and indirectly by attracting external support, enhancing the

startup's likelihood of achieving a first economic transaction. We also underscore that ET age diversity attracts external support in the form of knowledge-based and financial support: indeed, the higher the diversity, the larger the probability of obtaining aid from the external network. In addition, our findings underline the importance of receiving external support for achieving early entrepreneurial success.

Besides, our analysis suggests that the role of ETs' age diversity is more influential than the age of team leaders (CEO founders) in the nascent phase. This finding reveals that ETs deserve more scholarly attention, given their predominant role in ruling and leading their startups (Shah et al., 2019; Hawily et al., 2024). Although the role of ET age diversity was more influential, we also found that team age diversity and team leader age are complementary, and they do not substitute each other.

The relationship between the team leader and other team members differs in an entrepreneurial context. Unlike teams in large organizations, these teams are founded on a shared commitment to each other as one entity and on a commitment to the future development of the startup (Zellmer-Bruhn et al., 2021). Our findings suggest that in entrepreneurial teams, generational diversity is strategic for addressing the challenges associated with launching new ventures. Older members tend to bring an established network of contacts, fundamental for the success and credibility of the venture. In parallel, younger members contribute cognitive flexibility and greater familiarity with digital technologies, including AI tools, or emerging marketing and communication approaches. The coexistence of these two perspectives is crucial for transforming an entrepreneurial idea into concrete products and services launched in the market. Recognizing the complementary role of diversity and age of the leader can inform balanced role and task distribution to team members, and practices favouring interchange of ideas and experiences.

Ethics Declaration

Ethical clearance was not required for the research.

AI Declaration

AI was not used to carry out the investigation discussed in this paper.

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Innovating Together: The Power of Clusters in Poland's Social Economy

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Abstract: The aim of the paper is to analyze social economy clusters (SECs) as innovative organizational structures that bring together social enterprises (SEs) and other actors to jointly solve social, economic, and environmental challenges. The article examines the role of SECs in fostering the development of SEs, focusing on the areas: implementation of innovative solutions, management of business operations, and creation of social and environmental impact. We assess how the clusters facilitate cooperation, knowledge exchange among SEs, and increase their visibility. The research includes a case study analysis of a specific SEC from Poland - the Cluster of Social Economy Initiatives (Klaster Inicjatyw Ekonomii Społecznej, KIES). This case was selected because it provides a practical example of how social economy principles can be implemented within a cluster framework. The analysis focuses on the cluster's structure, objectives, member composition, governance model, and the mechanisms it employs to promote both economic development and social cohesion. SECs, as a form of cooperation between different actors (e.g. NGOs, SEs, public administration, financial institutions), may be a response to the growing demand for innovative solutions for sustainable development. The cluster as an organization based on cross-sectoral cooperation allows for a better exchange of knowledge, resources, and innovations, which can be crucial for sustainable development. The Polish context shows that European Union (EU) funds have played a key role in the creation of SECs, but their long-term viability depends on local leadership, political will, and the creation of a broader enabling environment. The findings will provide policymakers, practitioners, and researchers with valuable information on how SECs can promote economic inclusion, environmental responsibility, and social innovation regionally and nationally.

Keywords: Social Economy Clusters, Sustainable Development, Social Innovation

1. Introduction

SECs represent a new generation of organizational models that go beyond traditional industrial clustering. They are based on the principles of solidarity, inclusiveness, and democratic governance, promoting open innovation ecosystems that integrate SEs, public institutions, research organizations, and civil society. Through trust-based cooperation and social capital, clusters accelerate the development of social innovations, improve resource efficiency, and build collective problem-solving capacity. In this context, cluster-based strategic management can increase organizational efficiency and enable the creation of shared value, local resilience, and the implementation of the SDGs.

This paper aims to explore SECs as innovative organizational models that unite SEs and other stakeholders to collaboratively address social, economic, and environmental challenges. It investigates how these clusters support the growth and development of SEs, with particular focus on three key areas: (1) the implementation of innovative solutions, (2) the management of business operations, and (3) the creation of social and environmental impact. The article assesses how clusters promote collaboration, facilitate knowledge exchange, and enhance the visibility of SEs. The analysis is set within the specific context of Poland, considering national characteristics as well as the opportunities and constraints arising from the country's membership in the EU—particularly access to European funds and support mechanisms.

2. Literature Review

2.1 Defining Social Economy Clusters

Clusters are a manifestation and tool of economy networking, i.e. the creation of links between entities based on cooperation, flow of knowledge, information, and innovation. This fits into the concept of network society, which assumes that the modern economy and society function through dynamic networks of relationships instead of rigid hierarchical structures (Castells, 2011). The network approach is a modern strategy for managing an organization in a constantly changing environment (Czakon, 2012). Network thinking and perception make it possible to see new possibilities, opportunities, and perspectives that are invisible with a conventional approach, which sees separation rather than connections. A natural, spontaneously formed network is based on authentic connections and the need to exchange, develop, and cooperate. The research underscores the role of social

capital in entrepreneurship development, suggesting that social networks significantly affect entrepreneurial success (Gedajlovic et al., 2013).

Traditional industry clusters are defined by geographic proximity and sectoral specialization, "as geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries and associated institutions in particular fields that compete but also co-operate" (Porter, 1998a). Cooke underlines that the idea of clustering improves innovation, learning, and competitiveness through spillovers, shared infrastructure, and inter-organizational trust (Cooke, 2001). According to Babiak (2011), a cluster is a network of vertical and horizontal links between enterprises, universities, and other organizations. The main goal of such cooperation is to achieve synergy or integration of the activities of many organizations. This reduces development and promotion costs, positively impacting the profitability of operations and the innovativeness of enterprises by facilitating transfer of information or solutions from science to industry, which contributes to regional prosperity. Successful cluster models improve the productivity of firms both within and outside the cluster, attract talent, increase employment opportunities, improve job quality, and encourage innovation across the cluster. These impacts contribute to regional economic prosperity and economic growth.

The idea of clustering is a new trend and growing social movement in the EU countries in the sector of social economy (European Commission, 2021a). The concept of social economy (SE) has attracted attention of researchers around the world because of its potential to stimulate social innovation, develop solutions to local social and environmental challenges, and mobilize citizens, public policy makers, researchers, and businesses (Compère et al., 2021). In general, social economy is an umbrella term encompassing a variety of concepts that prioritize social and environmental needs over profit, adhering to principles that differ from those associated with capitalist and individualist concepts (Yi, 2023). The heart of the social economy is social entrepreneurship and social enterprise. According to the definition of Defourny and Nyssens (2008), initiatives classified as social entrepreneurship should be characterized by meeting economic and social criteria. The economic criteria include carrying out continuous and regular activities based on economic instruments; independence, sovereignty of the institution in relation to public institutions; bearing economic risks; and having paid staff. In turn, the social criteria include: a clear purpose benefiting the community; the grassroots, civic nature of the initiative; a democratic management system; the participatory nature of the activity; limited distribution of profit. Many of the initiatives undertaken by social economy have proven to be innovative in solving socio-economic and environmental problems. Hence, the innovative nature of the concept is emphasized. Social entrepreneurs create innovative solutions to address important and neglected societal problems, mobilising the ideas, capacities, resources, and social arrangements required for sustainable social transformations (Bornstein, 2004). One of the manifestations of innovative approaches to solving social problems by social economy entities (SEEs) can be clusters.

SECs or "cluster of social and ecological innovation" are defined as "groups of social economy enterprises and other related supporting and economic actors that cooperate in a particular location to increase their joint social and ecologic impact by enhancing their cooperation, pooling resources and innovation capacity" (ECCP, 2025). The concept of SECs refers to organized, place-based networks of interrelated SEs and support actors (Fig. 1), including: NGOs, cooperatives, foundations, public institutions, academia, and financial entities that cooperate to address shared social and environmental challenges. Unlike traditional industrial clusters, which focus on profit, SECs emphasize values such as solidarity, inclusion, democratic governance, and sustainability. They provide a structured framework for cooperation that enhances collective capacity, accelerates social innovation, and facilitates territorial development, especially in regions with structural disadvantages (Borzaga and Bodini, 2014). The implementation of social innovation within SECs is significant as a process of seeking opportunities to provide solutions to existing social problems.



Figure 1: The entities of SECs

Source: own elaboration based on: Tanimoto, 2008, p. 12.

According to Polish law there is no official definition of a cluster. This results in a flexible understanding of the concept of clusters and impacts the creation of conditions that enable their operation and development (Piotrowski, 2019). This makes it difficult to conduct empirical analyses, especially for clusters in the field of social economy, as initiatives of this kind are recognized and named in different ways, including SECs, social economy initiatives cluster, social innovation cluster, etc. In this article, we define a SEC as a cluster of SEEs, operating within one sector or similar sectors that are in close geographic proximity and cooperate closely. It is important to emphasize that SEEs can also join other cluster-type networks, which are created with the participation of private enterprises and public entities. Examples of such networks in Poland, which are also joined by SEEs, are: regional product clusters, renewable energy clusters, and tourism clusters.

2.2 Social Economy Clusters' Role in Fostering Sustainable Development

The role and significance of clusters have been emphasized by many researchers. Bărbulescu et al. (2021) point out that innovation clusters, especially in the small and medium-sized enterprises (SMEs) sector, play a key role in the development of entrepreneurship ecosystems. They facilitate cooperation between different stakeholders, leading to increased innovation and sustainable development. According to the OECD report (OECD, 2009) clusters contribute to innovation and entrepreneurship by fostering collaboration between companies, research institutions and governments, strengthening knowledge sharing and driving regional economic growth.

The importance of integration and clustering in creating sustainable economic growth is emphasized by Popkova et al. (2017). An analysis of how developed countries promote cluster initiatives in entrepreneurship shows that today's innovative economy operates through business networks. The cluster strategy in contemporary global practice is an important tool of public policy to increase the competitiveness of national economies. This means that the most competitive spheres develop based on the principle of clusters, and support for the construction of clusters increases the country's economic competitiveness. Sánchez-García et al. (2023) proved a positive and significant relationship between industrial agglomeration in territorial clusters and the innovative performance of firms. The improvement in innovativeness' level is partly due to the positive influence of social networks and collaboration within the clusters. Therefore, locating a business in a specialized, industry-focused area is strategically important, particularly for boosting innovation. Spencer et al. (2009) show that when industries locate in an urban region with a critical mass of related industries, they tend to generate both higher incomes and rates of employment growth. They prove the overall prevalence of clustering within a city-region is positively associated with income levels and employment growth. Understanding a cluster involves analyzing vertical and horizontal linkages between firms and industries, as well as institutional and regulatory influences. Strong clusters promote productivity, innovation, and competitiveness by enabling knowledge spillovers and efficient supply chains. Their boundaries are fluid and evolve with technological, regulatory and market changes. Clusters serve to enhance regional competitiveness and drive sustainable economic growth through collaboration, specialization, and continuous innovation (Porter, 1998b).

On the other hand, Rocha et al. (2019) noted that previous studies focused more on the economic performance of clusters and less on regional social cohesion. Initially clusters can reduce poverty and increase employment, but over time, the influx of specialized workers from outside the region can disrupt social ties, weaken informal networks, and undermine cohesion, which in turn limits knowledge sharing, innovation and ultimately undermines economic growth.

Therefore, for SECs to enhance rather than undermine regional social cohesion, they must be managed with a strong focus on social integration and inclusivity. Unlike traditional clusters that prioritize economic efficiency, SECs emphasize participation, equity, and the reinvestment of surpluses into communities' development. They play a significant role in fostering sustainable development through social sustainability within social entrepreneurship. Key strategies for achieving social sustainability include value creation, forming partnerships, and fostering social innovation. Moreover, social economy business models are particularly well suited to creating local and collective initiatives that generate environmental and social benefits within the framework of social cluster initiatives contributing to SDGs.

3. Development of Social Economy Clusters in Poland and the Role of EU Funds

The social economy has been developing in Poland since the 1990s, but it gained prominence only upon accession to the EU in 2004 (Ciepielewska-Kowalik, 2020). The support for its development has been provided by public policy and access to public funding sources, particularly EU funds. These funds provide each member state with the opportunity to build or supplement the system for financing SEs, to gradually strive to create a comprehensive offer consisting of effective financial tools, that are adequate to their business profiles, size, stages and development plans and needs. On the other hand, the legal conditions for granting such assistance allow the implementation of policy priorities important to the financing organization and can also drive changes in the operation of those interested in support.

The potential and importance of SEEs in solving social problems and contributing to sustainable economic growth has long been recognized. The European Commission has put forward a series of policy documents aimed at creating a favorable climate for SEs, in close cooperation with member states and various stakeholders. Some of the most important were the Social Business Initiative (SBI) adopted in 2011 (European Commission, 2011) and Social Economy Action Plan adopted in 2021 (European Commission, 2021b). The Commission emphasizes the need to support activities and provide opportunities for innovative business practices, cooperation and clusters, as well as the development of new economic sectors. Assistance is provided through the European Social Fund Plus (ESF+), the European Regional Development Fund (ERDF), and the Just Transition Fund to enable local and regional governments to enhance collaboration with social economy stakeholders. The largest source of funding for these activities has been so far the ESF. Promoting the social economy has been one of the EFS's priorities in previous programming periods and is one of the specific objectives of ESF+ today and supporting the development of SEs and the emergence of a social investment market - the operational objective of this fund. Poland is the largest beneficiary of EU cohesion policy funds, which creates a special context also for the development of the social economy. Support for the creation of a network of SEEs has been possible in recent years both directly (programs directly supporting SEEs) and indirectly (programs aimed at entities coordinating the development of the social economy sector in the regions).

Research indicates that the propensity of Polish enterprises to cooperate, as well as with the sphere of science and the business environment, is relatively low, mainly due to cultural factors (Hołub-Iwan and Małachowska, 2008). The formation of cooperative ties between enterprises and scientific units began only in 2004 with Poland's accession to the EU and access to EU funds (Fig. 2).

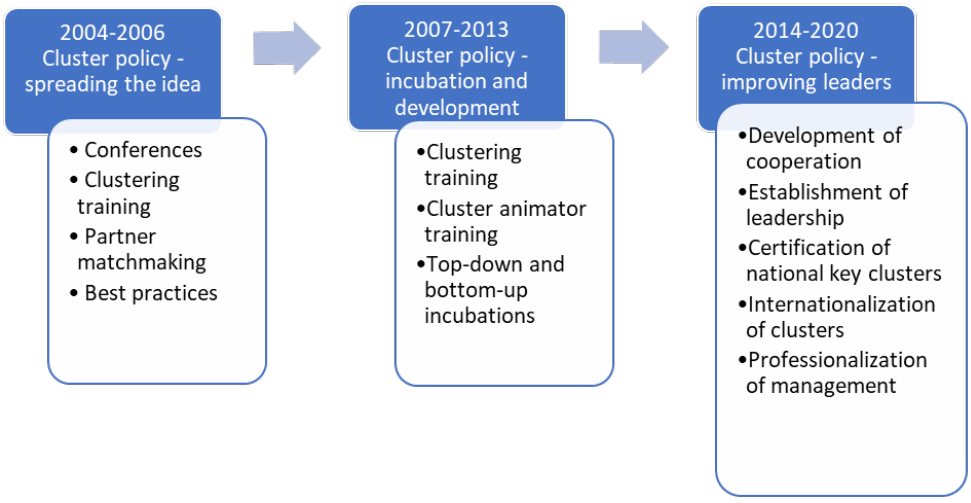


Figure 2: Development of cluster policy in Poland

Source: Choińska et al, 2020, p. 23.

The development of cluster policies for SEEs has followed this general trend albeit with a noticeable delay. However, according to recent studies, 40% of SEs now belong to various networks, agreements, and coalitions. Notably, this percentage includes both formal and informal associations (Bednarek et al., 2024). These data come from a report based on research conducted among a representative group of SEs in 2024 by the Klon/Jawor Association, which has been studying NGOs in Poland, including SEEs, since 2000. This research shows that

entities with longer operational history (over 10 years) and those with annual revenues exceeding PLN 500,000 are much more likely to associate. This suggests that association is a certain later stage in the development of an enterprise, once it has gained more resources and experience. Most often, SEs organize themselves in networks of a territorial nature: local, regional or national; much less often in sectoral (branch) networks or networks of SEs. The low percentage of branch networks may be a consequence of the high fragmentation of the main areas of operation among SEs. During interviews with social enterprise leaders, most of them were positive about their experiences in networks so far, and they pointed to the many benefits that networking gives them. However, they also mentioned missed experiences with association, and these were mainly related to networking under a particular project, which was not necessarily based on a real need of the actors in question. It is worth noting that the creation of branch networks and clusters was included in the National Program for the Development of the Social Economy as a priority measure to strengthen the economic and social potential of SEEs (KPRES, 2022).

The need to establish SECs emerges from the challenges facing SEs in Poland. These include a reluctance among non-profit organizations to engage in business activity, limited demand for goods and services provided by SEs from public authorities, market competition and individual clients, poor managerial skills among managers of SEs, poor economic condition of SEs, weak intermediary structures and networks representing SEs as well as negative public perception of SEs (European Commission, 2020). To increase the efficiency of their activities and overcome the barriers, Bembenek and Kowalska (2015) advocate building grassroots social cluster initiatives to increase the intensity of their cooperation with the local actors operating in the social economy, as well as with R&D entities and local authorities. They confirm that the operation of these types of clusters positively strengthens cross-sector partnerships and fosters efficient problem solving. The development of economic clusters requires appropriate conditions and formal environment, as well as a stable political will, supported by real financial and non-financial support for entities coordinating and animating the processes of modernization and development of industrial territories (Lechwar and Wisz, 2018).

Poland still lacks comprehensive national and regional policies to support the creation and development of social clusters. The EU has been actively financing the development of SEEs and social innovation for many years, and it also supports the emergence of cluster initiatives among SEEs. The stimulation of with EU funding addresses several key stakeholders, including social entrepreneurs, non-governmental organisations, regional social policy agencies, universities, and other institutions. Through targeted funding programmes, the EU actively supports the development of SECs, enabling them to scale their impact, increase knowledge exchange and strengthen the social economy ecosystem. EU support for SECs is in line with its broader policy goals of social cohesion, green transformation and inclusive growth, making such funding a strategic tool for systemic social innovation.

4. Cluster of Social Economy Initiatives - a Case Study

This case study was developed using a qualitative research approach based on the analysis of project documentation, implementation reports and materials related to the Cluster of Social Economy Initiatives (Klaster Inicjatyw Ekonomii Społecznej - KIES), which was created under the project "Jump to the Network", co-financed by the ESF. The case study provides a structured overview of the objectives, activities and results elaborated by KIES under the project to present it as a good example of clustering initiative in the social economy sector in Poland. The case study outlines the cluster's current and future goals, focusing on strategic management development and cross-regional cooperation among social economy organizations. The presented data reflects the progress of the ongoing project and its anticipated activities and results.

4.1 About *KIES*

KIES was established under the project "Jump to the Network", which was implemented by the Wałbrzych Regional Fund within the framework of the Operational Programme "Development of Knowledge and Education" (PO WER), Priority Axis II: Effective Public Policies for the Labour Market, Economy and Education, Measure 2.9: Development of social economy. The concept of the project was developed by the Ministry of Family, Labor and Social Policy of Poland. The project had a total value of over 2 million PLN and was fully financed by the EU (Jump in the network, 2025).

4.2 About the Project

The project was aimed at strengthening the socioeconomic potential of SEEs by expanding advisory and training support related to creating and developing regional and supra-regional networks of SEEs, including partnerships, clusters, and cooperative consortia.

The project targeted 80 SEEs, including 40 SEs, 20 entrepreneurs from four regions in Poland: Lower Silesia, Wielkopolska, Lubuskie and Opole. The project focused on helping SEs join existing business clusters and on building a supra-regional sectoral network of SMEs.

The project activities began with a needs assessment of the target group. This analysis formed the basis for providing tailored advisory and training support. Networking meetings were organized to encourage the creation of partnerships, networks, clusters and consortia, and to promote the integration of SMEs into existing business clusters. A key element was creation of a supra-regional sectoral network. The network received support to ensure the sustainability of the collaboration by increasing visibility and branding. The exchange of good practices related to clustering and sectoral networking was also facilitated. Participants received ongoing support from social economy experts, as well as guidance, marketing support and access to training, networking opportunities, study visits, a database of good practices and the opportunity to participate in national and international trade fairs.

The project increased the networking capacity of the target group. One interregional sectoral network, KIES, was established, bringing together more than 12 social economy entities, including one cooperative consortium and one non-social economy entrepreneur. Additionally, five SEEs were successfully integrated into existing interregional business clusters (Jump to the Network, 2025). Furthermore, a model was developed to assist other SEEs in forming and developing regional and interregional networks, including clusters and cooperative consortia.

4.3 *KIES* Goals

The cluster establishes partnerships among SEEs, the academic institutions, businesses and public organizations. The cluster undertakes lobbying activities and supports its members in legal, economic and organizational matters. The cluster actively encourages entrepreneurship and standardization of services, connecting SEEs to strengthen cooperation. The cluster promotes its members' offering and seeks financing for development. It also represents its members' interests.

The cluster cooperates with public administration to improve conditions for social entrepreneurship combining knowledge resources within and outside the network. It also implements joint marketing strategies to increase the visibility and reach of the initiative. The cluster carries out educational, cultural and social initiatives, promoting sustainable development in all areas of activity.

4.4 Model of Support for Social Economy Clusters

The model developed under the "Jump to the Network" project contains a detailed guide with practical instructions on creating a cluster and integrating new members into existing clusters in the social economy sector. The model solution (Fig. 3) includes the following elements (Rychły-Mierzwa, 2022):

1. Initial definition of partnerships – this phase focuses on defining the scope and purpose of the network. A diagnosis assessed the needs and potential of participating social economy actors and SEs, including their willingness to co-create new networks. This helped to clarify the potential for innovation and identify barriers to cooperation.
2. Facilitating cooperation - participants were given a list of potential partners and took part in networking events which helped to initiate direct contact and foster early partnerships. Preparatory and marketing tools increased participants' confidence and visibility, strengthening their willingness to collaborate and exchange knowledge.
3. Networking and integration with existing clusters - workshops and working groups developed a common vision and organizational framework for the emerging network. This resulted in the creation of a cluster of SE initiatives, the establishment of a cluster governance body, the strengthening of strategic coordination of business operations, and the enabling of co-creation of social innovation initiatives.

4. Supporting the sustainability and growth of the network - promotional strategies and visual identification strengthened the network's image. Experts supported the cluster's strategic development, focusing on brand visibility and partner engagement. These efforts aimed at sustaining the cluster's long-term social and environmental impact by encouraging collaboration, pooling resources, and community-driven innovation.

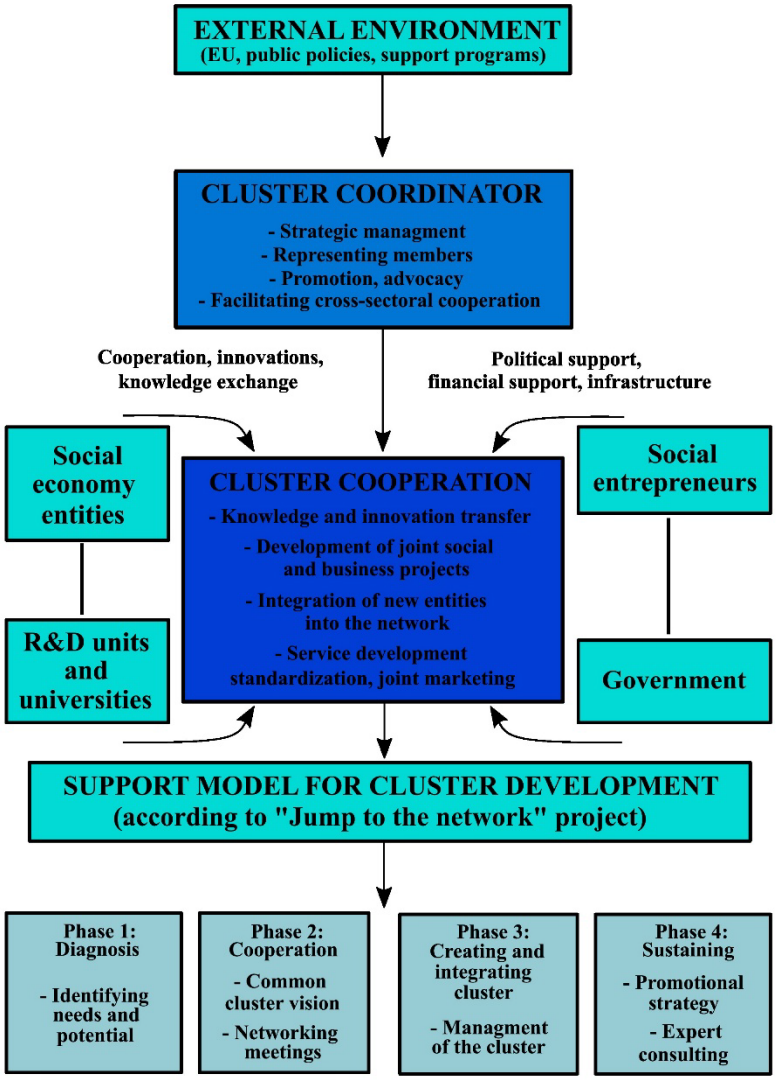


Figure 3: Model of support for SECs elaborated by KIES

Source: own elaboration based on: Rychły-Mierzwa, 2022.

5. Conclusions and recommendations

SECs, such as the KIES, demonstrate how strategic cooperation among SEEs can significantly increase their impact, efficiency, and sustainability. Clusters provide a robust framework for empowering SEs and driving inclusive, sustainable regional development by establishing structured governance, encouraging cross-sectoral collaboration, and fostering innovation. SECs play a pivotal role in fostering sustainable development by creating synergies between social and environmental goals, managing resources effectively, and promoting economic and social inclusivity.

Successful SEC implementation largely depends on strategic management practices that integrate and align different actors toward common goals. This process presents significant opportunities and challenges, which align with findings in the literature. As Bărbulescu et al. (2021) concluded, our case confirms that SECs can play a transformative role in regional entrepreneurship ecosystems by enhancing social innovation and inclusion. The KIES shows that clusters tailored to the needs of SEEs facilitate cross-sectoral collaboration, capacity development and social value creation.

In the Polish context, while EU funds have been instrumental in launching SECs, their long-term viability depends on local leadership and an enabling environment (Ciepielewska-Kowalik, 2020). Without systemic support, clusters may not reach their full potential or meaningfully contribute to regional inclusive development. Clusters should be incorporated into broader sustainable development strategies, and place-based policies that prioritize innovation and community integration should be implemented. These findings suggest that more attention should be given to the development of clusters in the social economy, which focuses on strengthening social cohesion.

Further research is needed to analyze the long-term effects of SECs on social cohesion in different regional contexts. Examining the effectiveness of different types of clusters could provide insight into the most influential organizational forms.

Ethic Declaration

Ethical approval is not required since the research is not interventional, does not operate on sensitive data and does not have a clinical nature.

AI Declaration

AI tools weren't used in the creation of the paper.

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Andragogy and Remote Executive Education: A Case Study on Live Learning for Entrepreneurs in Brazil

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Abstract: This paper examines the design, delivery, and participant perceptions of the G4 Journey program, a remote executive education initiative in Brazil that integrates andragogical principles, generative artificial intelligence (AI), and Visible Thinking routines. While remote learning has become increasingly prevalent, existing research often overlooks tailored approaches that address the immediate, practical learning needs of entrepreneurial leaders in dynamic environments. Using qualitative feedback gathered from six participant cohorts through post-session surveys, this study explores how mentor-led, technology-enhanced learning experiences can deliver actionable, context-specific knowledge. The analysis reveals the value of combining structured content, interactive dialogue, and AI-driven personalization to promote learner autonomy, critical reflection, and practical application. Findings demonstrate how integrating problem-based learning, expert mentoring, and technology-supported diagnostics can support adult learning principles such as relevance, authenticity, and social learning. The study contributes to the literature on remote corporate education by offering an applied case of learner-centred, technology-enhanced design, while also identifying implications for instructional design, limitations related to qualitative scope and context specificity, and directions for future research in developing scalable, adaptive learning solutions.

Keywords: Andragogy, Remote Learning, Executive Education, Methodology, Artificial Intelligence, Visible Thinking

1. Introduction

Remote learning itself is not new, with a wealth of experience and research in this field, particularly accelerated during the pandemic. However, this paper does not follow a purely technological or access-focused perspective. Instead, it considers how entrepreneurship and business practice demand learning that is immediately applicable—knowledge and skills that can be transferred to real contexts and challenges in the short term. Unlike traditional, long-term academic programs, this approach relies on short, intensive immersions centred on dialogue with experienced mentors rather than theoretical instruction alone.

In this context, robust theoretical frameworks are indispensable for guiding meaningful learning-design decisions. Accordingly, this paper uses Visible Learning (Hattie, 2009) and Making Thinking Visible (Ritchhart, Church, and Morrison, 2011) as primary references to explore how andragogical strengths can be activated in corporate remote education. These works emphasize principles such as clear objectives, effective feedback, learner autonomy, and routines that encourage participants to externalize and reflect on their thinking processes — all critical components in adult learning.

At the same time, the increasing integration of generative artificial intelligence (AI) offers opportunities to personalize, adapt, and scale learning experiences. By leveraging AI-driven diagnostics, prompts, and validation mechanisms, remote education can provide tailored, context-specific insights that support entrepreneurial decision-making and strategy. This combination of human-centred mentoring and technology-enhanced design represents an evolving field in adult education that demands further applied exploration.

Despite the proliferation of online education research—particularly accelerated during the pandemic—there remains a limited understanding of how adult learning theory can be systematically applied in executive education contexts requiring immediate, practical outcomes. Much of the existing literature focuses on formal higher education or large-scale training initiatives, often overlooking tailored approaches for entrepreneurial

leaders who must make high-stakes decisions in dynamic environments (Brookfield, 1986; Knowles, 1984). Moreover, while generative AI offers unprecedented opportunities for personalization and scaling, its pedagogical integration in remote learning for entrepreneurs remains underexplored. Addressing these gaps is critical for designing programs that not only transmit knowledge but also build the strategic thinking and adaptive capacity essential for sustainable business growth. This paper responds to that need by analysing the design, delivery, and participant perceptions of the G4 Journey program—a structured, mentor-led, technology-supported initiative developed in Brazil—offering an applied case of learner-centred, technology-enhanced design that demonstrates how generative AI, problem-based learning, and Visible Thinking routines can deliver actionable, relevant education in remote corporate settings.

2. G4 Educação and the G4 Journey Program

G4 Educação is a Brazilian organization dedicated to delivering practical, high-impact learning experiences to help entrepreneurs build sustainable businesses and reduce social inequality. Its mission includes enabling participants to generate one million jobs in Brazil by 2030, supporting inclusive economic development, and empowering small and medium-sized enterprises (SMEs).

To achieve this, G4 Educação offers programs that combine academic rigor, applied methodologies, experienced mentorship, and opportunities for immediate application in their businesses. Among these, the G4 Journey is a targeted educational response for entrepreneurs seeking structured, immediately applicable learning.

The G4 Journey is designed to:

- Address the limited access entrepreneurs face to structured, actionable learning opportunities.
- Combine practical learning phases (“learn by doing”), personalized mentoring, sector-specific checkpoints, and access to a dedicated entrepreneur community.
- Focus on critical business areas such as revenue growth, financial optimization, operational efficiency, and people, culture, and leadership.
- Produce tangible outputs, including business diagnostics, mentoring reports, and customized strategies that integrate theory with practice.

By linking immediate business needs with structured educational design, the G4 Journey demonstrates how executive learning programs can deliver practical results while also contributing theoretical insights to adult learning and remote education.

3. Andragogical Best Practices Integrated Into the Lived Curriculum

The G4 Journey program integrates andragogical best practices to enhance participants’ learning experiences. A central strength is its focus on content applicability: mentors co-design exercises introduced progressively, allowing participants to connect new concepts directly to their real business challenges. Participants often remarked that these examples felt tailored to their specific situations, reflecting adult learning theory’s emphasis on relevance, immediate application, and learner involvement.

Adults are motivated to learn when they perceive that learning will help them perform tasks or address problems they face in life. They are life-centred (or task-centred, or problem-centred) in their orientation, more interested in subjects with immediate relevance to their work or personal life. Learning is enriched when they draw on their experiences, and they respond best to active, reflective experiences rather than passive memorization (Knowles, 1984, p. 14).

Participants consistently reported that connecting theory to their business contexts made the content meaningful and actionable, reinforcing these principles. Another key feature of the program is the emphasis on interaction during live sessions. Rather than relying on one-way delivery, mentors encourage dialogue, address questions in real time, and facilitate peer-to-peer exchanges, creating an inclusive atmosphere that promotes social learning.

Effective learning integrates cognitive, emotional, and social dimensions in a unified process of personal development. The cognitive provides content, the emotional ensures motivation and meaning, and the social enables interaction and shared understanding. This integration makes adult learning authentic and transformative (Illeris, 2003, p. 398).

This approach is evident in how participants remain engaged not only with mentors but with one another,

transforming learning from individual comprehension into shared insight. The mentors' storytelling approach further shapes the experience by framing concepts through relatable narratives and real-world examples. This strategy encourages learners to externalize and reflect on their thinking, reinforcing that adults learn best when new knowledge is anchored in personal experience and collaborative dialogue.

Making thinking visible allows learners to externalize, share, and reflect on their thought processes. It fosters environments where understanding is co-constructed, with learners as active participants in making sense of information. This practice supports deeper engagement, autonomy, and collaborative learning (Ritchhart and Church, 2020, p. 28).

Overall, participant feedback highlighted how these narratives felt tailored to their realities, enhancing the content's relevance and utility. The program's instructional design also deliberately balances knowledge (20%), skills (40%), and attitudes (40%), ensuring learning addresses cognitive, behavioural, and emotional dimensions simultaneously.

4. G4 Methodology

The methodology in this study is rooted in educational design research (McKenney and Reeves, 2012), where the development, implementation, and refinement of learning products occur through iterative cycles of design, evaluation, and reflection. The G4 methodology served as the guiding framework for designing and delivering the G4 Journey program. Drawing on instructional design principles, andragogical theory (Knowles, 1984), and executive learning best practices, it offers a structured process that aligns learning objectives, delivery formats, and participant needs.

Unfolding across four interconnected phases, the G4 methodology provides a systematic blueprint for designing educational programs. These phases demonstrate how relevance, practicality, and applicability are embedded throughout the learning journey.

- Discovery and Planning

The initial phase focuses on product ideation and positioning using the G4 Working Backwards template. Activities include benchmarking, interviews with clients, experts, and stakeholders, empathy mapping, and tools such as the Value Proposition Canvas, CSD Matrix, and 5W2H. Sales calls are analysed, and P&L simulations are run as needed to confirm financial feasibility. This phase culminates in defining the value proposition that guides all subsequent stages.

- Syllabus and Structure Definition

At this stage, the syllabus is developed with clear guidelines for organizing modules, topics, and objectives. Mentors are selected, and the program structure—covering format, duration, and delivery methods—is finalized. A presentation and pitch are then prepared to communicate the proposal clearly and effectively.

- Content Development

Lesson plans, activities, and materials are developed using structured models that account for the target audience's expected knowledge, skills, and attitudes (KSA). All content aligns with the defined value proposition and syllabus to ensure coherence and relevance.

- Continuous Learning Flow

Finally, the methodology incorporates a Next Best Offer (NBO) approach, adding activations, complementary content, and supporting materials that promote continuous learning and deepen engagement within the G4 ecosystem.

4.1 Application of G4 Content Within the Methodological Framework

G4 Content is designed to deliver more than information; it creates a complete learning experience where each participant plays an active role and remains engaged. Grounded in three core principles—Relevance, Practicality, and Applicability—it ensures learning is immediately useful and tailored to real business challenges. By embedding these principles, G4 fosters trust, empathy, personal connection, and genuine value by placing the learner at the centre.

This framework represents the G4 Methodology in practice, visually summarizing how these principles and

design elements integrate into a cohesive approach (see Figure 1).

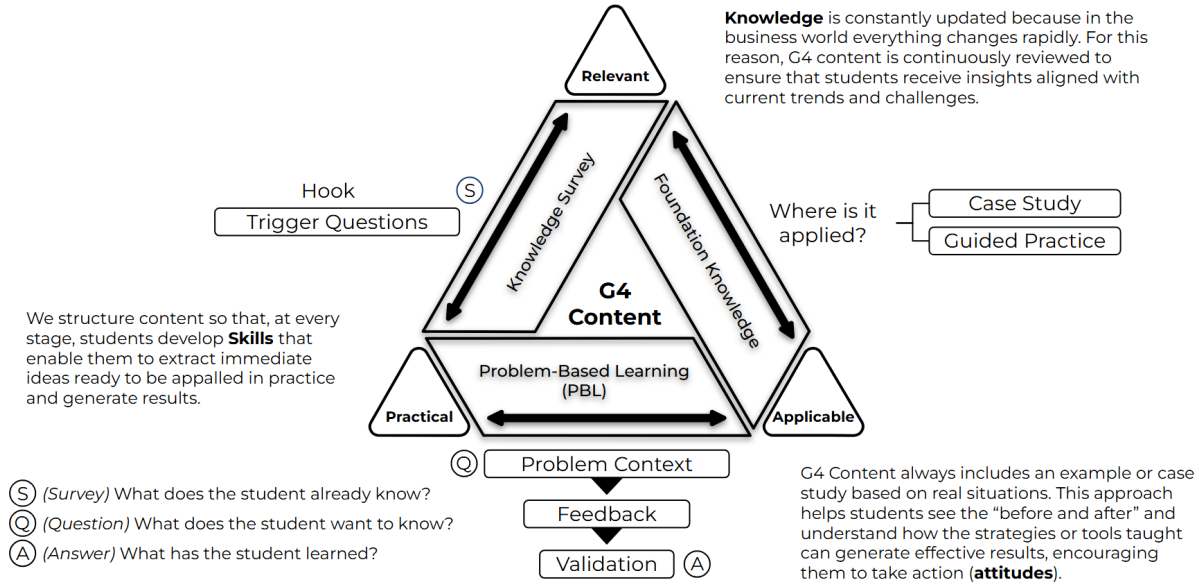


Figure 1: G4 Methodology framework

The figure shows G4 Content with Problem-Based Learning (PBL) at its core, supported by Relevance, Practicality, and Applicability. It also emphasizes Knowledge Survey and Foundation Knowledge as supports for learning transitions. Applicability is strengthened through Case Studies and Guided Practice, helping learners see how concepts apply in real scenarios. Feedback and Validation processes support learning cycles.

A key component is the SQA Framework:

- S (Survey): What does the student already know?
- Q (Question): What does the student want to know?
- A (Answer): What has the student learned?

This approach ensures learning remains connected to prior knowledge, personal goals, and clear outcomes.

4.1.1 Relevance

Knowledge must be highly useful and tailored to the target audience. Content is continuously updated to reflect the rapidly changing business environment. Through active listening and ongoing diagnostics—during design, delivery, and improvement cycles—G4 identifies what learners know, what they need, and the problems they aim to solve, keeping material current and market-aligned.

4.1.2 Practicality

Content is structured so that at every stage, participants develop skills enabling them to extract actionable insights for immediate application. A PBL approach introduces theoretical principles through real problems, stimulating critical thinking and driving implementation.

4.1.3 Applicability

Theory becomes transformative only when put into practice. All sessions are led by experienced mentors who share real-world lessons and case studies. This approach helps learners see results clearly and encourages immediate action.

The G4 Methodology, with its structured phases and integrated content design, illustrates how educational product development can align with adult learning principles (Knowles, 1984; Brookfield, 1986) and executive education. It reflects a design-based research orientation (McKenney and Reeves, 2012), where iterative cycles of design, implementation, and reflection drive continuous improvement.

By combining rigorous planning, learner-centred design, and ongoing refinement guided by feedback, diagnostics, and engagement metrics, this methodology ensures programs are well-conceived, dynamic, and responsive to real-world challenges. It demonstrates how technology-enhanced education can bridge theory and practice, fostering relevance, practicality, and applicability in remote learning for entrepreneurs.

Together, these elements show how G4 Educação integrates instructional design and andragogical theory to create dynamic, learner-centred experiences.

4.2 Program Structure and Implementation of the G4 Journey

The G4 Journey is structured as a twelve-month developmental framework to foster sustainable learning and business transformation among entrepreneurs. It comprises four sequential thematic pillars, each addressing critical areas of organizational growth through an iterative, problem-centred methodology (Merrill, 2002):

- Quarter 1: Revenue Growth.
- Quarter 2: People, Culture, and Leadership.
- Quarter 3: Financial Optimization.
- Quarter 4: Operational Efficiency.

Each module begins with a diagnostic assessment to identify organizational strengths and gaps, followed by an intensive series of six live, synchronous sessions. Participants receive a strategic dossier summarizing recommendations based on these activities. The program also includes additional learning mechanisms designed to maintain engagement and encourage reflective practice:

- Biweekly sector-specific checkpoints.
- Monthly group mentoring sessions (Illeris, 2003).
- Quarterly one-on-one coaching sessions for feedback (Hattie and Timperley, 2007).

To support personalized learning and operational planning, the program incorporates generative AI tools aligned with Visible Thinking principles (Ritchhart and Church, 2020). It concludes with an in-person session aimed at consolidating learning through peer exchange.

4.2.1 Target Audience and Value Proposition

The G4 Journey is designed for founders and presidents of small and medium-sized enterprises (typically 5–50 employees, annual revenue above BRL 500,000) in early growth stages where scaling depends on strategic planning and operational discipline.

The program integrates structured diagnostics, guided mentoring, and feedback processes to support participants in developing practical strategies and applying learning outcomes directly to their business contexts.

Key components of the program include:

- Quarterly thematic focus to manage cognitive load and build mastery (Paas and Sweller, 2012).
- Customized business diagnostics and strategic dossiers.
- Live, mentor-led immersion sessions.
- Access to expert guidance and collaborative problem-solving.
- Peer communication channels for ongoing discussion.
- On-demand support for implementation challenges.

4.2.2 Generative AI Integration Across the Program Pillars

A distinguishing feature of the G4 Journey is its use of generative AI to enhance both learning activities and diagnostic processes. The proprietary digital platform functions as a learning management system (LMS) and interactive space for AI-assisted planning and reflection.

Each thematic module begins with a Business X-ray diagnostic that captures company details such as operating model, maturity stage, customer profiles, and structure. These inputs inform personalized learning paths and strategic planning.

Prompt engineering principles shape AI responses by structuring inputs based on user context and goals (Liu et al., 2023), delivering tailored, actionable feedback. To ensure quality, an AI-driven validation layer scores responses for clarity, completeness, and alignment with objectives while suggesting refinements. Throughout

the six-session immersions, participants engage with AI-generated prompts linked to session topics and company-specific challenges. This process culminates in a Strategic Dossier synthesizing:

- Content frameworks delivered in live sessions.
- Best practices and case-based knowledge relevant to the sector.
- Diagnostic insights and AI-supported reflections.

By applying principles from Visible Learning and Visible Thinking (Ritchhart and Church, 2020; Hattie, 2009), this approach supports participants in externalizing thought processes, receiving structured feedback, and refining understanding in authentic business contexts.

4.3 Visible Thinking and Visible Learning as emerging pillars of the G4 Methodology

As part of its ongoing focus on evidence-informed practice, G4 Educação has integrated principles from Visible Thinking and Visible Learning, drawing on work from Project Zero at the Harvard Graduate School of Education. Founded in 1967 by philosopher Nelson Goodman, Project Zero has developed frameworks and tools over six decades to foster deep learning, critical thinking, and creativity across disciplines.

Among these frameworks, Visible Thinking (VT) stands out for addressing a practical question: *What happens inside students' minds as they learn, and how can this process be made visible so they can reflect on it?* Adopting VT aligns with G4's goal of combining content and process, promoting metacognition, and providing instruments applicable in both in-person and online environments.

G4 applies these principles through specific routines. For example, *See–Think–Wonder* encourages observation, interpretation, and questioning during module introductions and case exploration. *I Used to Think… Now I Think…* supports learners in articulating shifts in understanding during post-activity reflection and mentoring.

When thinking is made visible, it helps students develop and extend their thinking while allowing teachers to assess understanding and plan for future learning. Visible thinking routines offer structures that guide students in engaging with ideas in new, deeper ways. Through this process, learners become more metacognitive and reflective about both the content they learn and how they learn it (Ritchhart and Church, 2020, p. 11).

These routines function both as tools supporting specific kinds of thinking and as structures shaping learning culture.

Routines serve as tools to support specific kinds of thinking and as structures that shape the culture of the classroom and the learning that takes place within it. They help teachers foster patterns of thinking that, over time, become habits of mind. By making these thinking processes explicit, opportunities are created for students to engage, reflect, and deepen understanding in a sustained way (Ritchhart and Church, 2020, p. 12).

By incorporating these routines, G4 aims to build a reflective learning culture where thinking processes are made visible, discussed openly, and collaboratively refined.

Table 1: Visible thinking routines applied at G4.

Visible thinking at G4		
Routine	Purpose	Application at G4
See – Think – Wonder	Stimulate observation, interpretation, and questioning.	Module introductions, case exploration.
I Used to Think… Now I Think…	Promote reflection on evolving understanding.	Post-activity reflection, mentoring sessions.
Think – Pair – Share	Encourage dialogue and collaborative reasoning.	Group tasks, cohort discussions.

By embedding visible thinking practices into its methodology, G4 emphasizes learner-centred design and promotes reflective, actionable learning that fosters critical thinking and deeper engagement.

5. Microteaching in the Continuous Improvement Process of the Mentor

After adopting Visible Thinking and Visible Learning principles, G4 Educação incorporated microteaching into its mentor development cycle to ensure these practices are applied effectively. In each session, mentors deliver brief, focused lessons to peers or supervisors and receive structured feedback for refinement.

A standardized observation rubric guides each session, enabling systematic reflection and formative feedback. The rubric includes:

- Context details (date, number of students, lesson theme).
- Student highlights (what students did well).
- Student growth areas (what students could improve).
- Mentor highlights (what the mentor did well).
- Mentor growth areas (what the mentor could improve).
- General comments on the lesson.

This structure promotes critical observation and reflection on teaching practice and student engagement. It supports the development of consistent, learner-centred facilitation aligned with reflective teaching principles.

Combining feedback with deliberate reflection is essential for improving teaching practice (Hattie and Timperley, 2007). Microteaching thus offers a practical, iterative mechanism for mentors to refine clarity, engagement strategies, and alignment with the program's educational objectives, ensuring that learning remains visible and actionable.

6. Results and Analysis of Participant Feedback

The results of this study are based on qualitative feedback collected from participants during and after their engagement with the G4 Journey program. Feedback was gathered through post-session surveys in which participants reflected on relevance, clarity, applicability, and overall impact. Analysis of responses from six participant cohorts reveals consistent patterns that align with adult learning principles, while also offering critical insights for refining the program.

Table 2: Key themes in participant feedback on the G4 Journey program.

Participant Feedback on the G4 Journey	
Theme	Feedback
Clarity and relevance of content	"I loved objectivity, practical examples, and dynamic class."
Applicability and usefulness	"Helped a lot, it seems the tools will really improve our planning."
Interactivity and learner engagement	"Class management and interaction were great."
Mentor role and personalization of learning	"Provocations encourage deeper reflection."
Challenges and areas for improvement	Material could have been shared beforehand"; "Addressed a topic that seemed simple but was difficult to apply.

A deeper analysis of participant feedback reveals that these themes were not isolated observations but often reflected interconnected dimensions of learning design. For example, participants who praised clarity and relevance also emphasized applicability, suggesting that well-structured content facilitated transfer of learning to business contexts. This supports Merrill's (2002) principle that authentic tasks and clear instructional sequences enhance adult education. Additionally, the emphasis on interactivity and peer exchanges highlights the program's success in fostering social learning environments, aligning with Illeris' (2003) multidimensional model where cognitive, emotional, and social elements must be integrated to produce meaningful change.

The mentor's role emerged as critical in personalizing learning and prompting reflection, demonstrating how expert facilitation supports learner autonomy (Knowles, 1984) while scaffolding critical thinking through structured routines such as See–Think–Wonder (Ritchhart and Church, 2020). Participants valued both human-centred mentoring and AI-assisted diagnostics, suggesting that these elements can be complementary rather

than competing. This points to the potential of hybrid designs that blend relational mentoring with scalable, context-sensitive technology—a concept underexplored in existing corporate learning research.

Such insights emphasize that effective remote executive education must address multiple dimensions simultaneously: clarity and applicability in content, interactivity and social learning in delivery, and personalization through both human and technological means. These findings underscore the importance of intentional design that aligns pedagogical strategies with the complex, real-world challenges entrepreneurs face, offering valuable guidance for educators, program designers, and researchers seeking to optimize adult learning in remote contexts.

The following sections unpack each of these themes individually, providing more detailed insights into participant perspectives and their implications for instructional design.

6.1 Clarity and Relevance of Content

Participants consistently valued the program's clear explanations and focus on real-world examples. This feedback reinforces the importance of authentic tasks in adult learning (Merrill, 2002) and validates the choice to integrate problem-based learning. It suggests that well-structured content with clear objectives effectively reduces cognitive load (Paas and Sweller, 2012), helping learners focus on application rather than rote memorization. For instructional design, this highlights the need to maintain clarity and relevance as core priorities to support transfer of learning into professional practice.

6.2 Applicability and Usefulness

Participants emphasized the immediate applicability of tools and frameworks, noting their usefulness for planning and decision-making. This aligns with andragogical principles (Knowles, 1984) that adult learners are motivated by content that solves real problems. The feedback suggests the program successfully supports work-based learning (Boud and Solomon, 2001) by bridging theory and practice. However, it also implies a need to ensure that all tools remain adaptable to diverse business contexts to maximize perceived value.

6.3 Interactivity and Learner Engagement

Comments about interactive elements, discussions, and peer exchanges point to the program's success in fostering social learning. This reflects the value of communities of practice (Lave and Wenger, 2000) where learning emerges through dialogue and shared problem-solving. Encouraging peer engagement not only sustains motivation but also deepens understanding by making thinking visible (Ritchhart and Church, 2020). For remote education design, these results support prioritizing collaborative formats even in online settings.

6.4 Mentor Role and Personalization of Learning

Participants highlighted the mentors' use of provocative questions and tailored guidance. This underscores the critical role of expert facilitation in adult learning (Eraut, 2007), enabling learners to externalize thinking and reflect on personal challenges. The feedback supports the program's inclusion of Visible Thinking routines, such as See–Think–Wonder, which encourage metacognitive awareness. For designers, this suggests maintaining a strong mentorship component with structured opportunities for reflection.

6.5 Challenges and Areas for Improvement

Participants also identified limitations, such as pacing issues and material overload. Requests for advance sharing of materials point to cognitive load concerns (Paas and Sweller, 2012) and the importance of scaffolding content delivery. These comments highlight the balance needed in remote education between content richness and manageability (Garrison and Vaughan, 2008). This feedback is essential for iterative program improvement, suggesting the need to revisit session design to allow more time for reflection and learner questions.

6.6 Interpretation and Implications

Overall, the feedback reveals that the G4 Journey effectively integrates problem-centred learning, mentor-guided dialogue, AI-enhanced personalization, and visible thinking routines to create an environment that is applied, relevant, and reflective. The findings suggest that combining these elements supports adult learners in

developing practical skills while also fostering critical thinking. Importantly, the feedback also surfaces tensions common in remote learning, such as balancing interactivity with content pacing. Addressing these will be crucial for optimizing learner experience and ensuring sustainable engagement. Beyond this program, the results offer insights for the design of other remote executive education initiatives aiming to balance personalization, relevance, and collaborative learning.

The qualitative feedback was collected using structured post-session surveys applied digitally at the end of each live immersion. Each survey contained a consistent set of open-ended questions such as: “What part of today’s session was most useful for your current business challenges?”, “Was there any concept or tool that you feel requires more clarification?”, and “How do you plan to apply what was discussed today in your company?”. Additionally, participants were asked to score each session across dimensions such as clarity, relevance, interactivity, and applicability using a 5-point Likert scale. This combination of open responses and structured ratings enabled thematic coding and pattern identification across six different cohorts, supporting triangulation and depth of analysis in alignment with design-based research methodologies.

7. Conclusion

This study examined the design, implementation, and perceived impact of the G4 Journey program, a remote executive education initiative that integrates andragogical principles with evidence-based methodologies such as Visible Thinking and generative AI. Participant feedback demonstrated alignment with adult learning principles, including clarity, relevance, immediate applicability, and engagement through interactive, reflective practices. The findings show how carefully designed remote education can support entrepreneurial learning by delivering actionable knowledge that addresses real business challenges in real time.

7.1 Theoretical Contribution

This research advances adult learning literature by providing an applied case of integrating generative AI, problem-based learning, and Visible Thinking routines in remote corporate education. It demonstrates how principles such as learner autonomy, authentic tasks, feedback, and social learning can be operationalized in mentor-led, technology-enhanced formats. The study also contributes to understanding how hybrid models—blending human facilitation and AI-supported personalization—can enrich learning design for complex, rapidly changing contexts.

7.2 Practical Applications

The results highlight the value of combining structured diagnostics, mentor facilitation, interactive learning strategies, and AI-driven personalization to support entrepreneurs. For educators and program designers, these findings emphasize the need to balance clarity and relevance with interactivity and cognitive load management. They also suggest the importance of embedding reflective practices and visible thinking routines to promote metacognition and critical reasoning. These insights can inform the development of more effective, learner-centred remote education experiences tailored to small and medium-sized business leaders in diverse sectors.

7.3 Study Limitations and Future Directions

While this study offers valuable insights, it is limited by its qualitative scope and its focus on Brazilian SMEs in the early growth stage. Reliance on participant self-report through post-session surveys may also introduce response bias. Future research could use longitudinal methods to examine sustained behaviour change and business outcomes. Additionally, exploring the model’s adaptability across cultural, sectoral, and regional contexts would strengthen its generalizability. Researchers might also investigate how advances in AI prompt engineering and personalization can further support reflective, context-sensitive learning in executive education.

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Ethics Declaration

This study was not subject to formal ethical clearance requirements, as it involved the analysis of anonymous participant feedback collected through standard program evaluation procedures.

AI Declaration

Artificial intelligence tools were employed to assist with text editing, consistency checking, and formatting. All content, interpretations, and conclusions remain the sole responsibility of the authors.

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AI-driven Business Models in the Data-information-intelligence Economy: The NRT Methodology

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Abstract: The exponential rise of Artificial Intelligence (AI) coupled with the continuous growth of big data led to the need for transforming traditional business models into AI-driven business models. These AI-driven business models are crucial in providing much needed Strategic Intelligence (SI) to strategic decision-makers. This research paper seeks to introduce the nominal ranking technique (NRT) methodology as a strategic methodology for streamlining the management of big data towards innovation. The NRT methodology is a structured and systematic approach, innovatively developed for the management of big data. The NRT methodology is further reinforced with the Pareto principle, also known as the 80/20 rule. The Pareto principle in the management of big data considers that 80 percent of insights derived often stems from 20 percent of the big data. When the NRT methodology is applied in the management of big data, four primary elements are considered, namely - 1) standard of inclusion of data, information and intelligence, 2) data cleansing, 3) relationship of data, information and intelligence, and 4) VARCS principles. VARCS refer to the validity, accuracy, reliability, credibility, and sufficiency of data, information and intelligence. The NRT methodology considers the volatile, uncertain, complex and ambiguous (VUCA) environments in which the world operates. The NRT methodology is an iterative process that can be applied in large-scale data-information-intelligence management initiatives, as it encourages adaptability based on ongoing findings and challenges. Overall, the strategic insights derived from the application of the NRT methodology highlight its potential as a valuable tool in the data-information-intelligence economy. By enhancing decision-making frameworks, promoting collaboration, identifying key variables, providing visual representations of data, and fostering continuous improvement, the NRT methodology significantly contributes to the effectiveness and success of complex business environments. Research data collected and analysed from content analysis determined that businesses are concerned about the strategic nature and use of data, information, and intelligence for strategic decision-making and innovation.

Keywords: Artificial Intelligence, AI-driven Business Models, Big Data, NRT Methodology, Pareto Principle, Strategic Intelligence

1. Introduction

In the data-information-intelligence economy, AI-driven business models are required to remain competitive and sustainable as a business. The NRT methodology provides a structured and systematic approach to managing big data in the data-information-intelligence economy. The NRT methodology considers four primary elements, positioned in a structured manner to ensure strategic management of big data. Data that have not gone through an analysis process cannot be used as information. Similarly, information that have not gone through an analysis process cannot be used as intelligence. As such the NRT methodology provides the structured and systematic approach to analyse data into information, and information into intelligence. Intelligence then provides the foundation on which sound decisions are based. The objective of this research paper is to introduce and illustrate the structured and systematic approach of the NRT methodology in managing big data, that can be adapted in an AI-driven business model in the data-information-intelligence economy.

2. Literature Review

AI continues to experience exponential growth, equally contributing to the growth of big data. The literature review covers in short AI, AI-driven business models, and the data-information-intelligence economy.

2.1 AI-driven Business Models and the Data-information-intelligence Economy

2.1.1 AI-driven Business Models

AI as a concept is not new, AI is the new norm. The first wave of AI was experienced in the early 1950's. To be precise, John McCarthy first coined the term "Artificial Intelligence" in 1956 (Marr, 2018). Ever since AI was coined in 1956, major advancements has been experienced (Tzirides et al, 2024). AI involves tasks of computers to understand human reasoning (McCarthy, 2007). According to Haenlein and Kaplan (2019) AI is a system's ability to interpret data, to learn from the data, and to use the learnings to achieve specific goals and tasks, by being able to adapt.

As business environments rapidly changes due to the exponential growth experienced in and by AI, new and innovative business models are required. AI-driven business models use AI technologies to create, deliver, and capture value innovatively for the business. Traditional business models rely on manual processes. AI-driven business models integrate machine learning, data analytics, and automation with AI, to enhance business operations and sustainability (Gibson, 2024).

2.1.2 The Data-information-intelligence Economy

In the data-information-intelligence economy, turning raw data into actionable intelligence is crucial. The relationship of data, information and intelligence is fundamental, with Chollet (2019) and Abu et al (2020) emphasising the importance of clean data as an input to accurate information leading to viable intelligence for strategic decision-making. According to a paper published by KPMG (2019) data is regarded as the most significant asset many organisations have, with global investment increasing in an effort to discover the full potential that can be mined from the data.

The process of managing big data has to be strategic, in order for strategic intelligence to be manifested.

3. Research Methodology

The NRT methodology was employed in the data collection and data analysis of a PhD study which entailed a much larger content analysis component than can be reported in this research paper. This research paper reports only on a portion which was part of a larger PhD study. In order for research data to be collected and analysed, a concurrent mixed method research strategy in a single-phase of data analysis was used. This led to the content analysis of the University of Johannesburg (UJ) Information and Knowledge Management (IKM) Department Strategic Information Management (SIM) business case studies (BCSs) (De Koker, 2025). According to Saunders et al (2016), "content analysis is an analytical technique that codes and categorises qualitative data in order to analyse them quantitatively". The content analysis in the case of this research is the application of the NRT methodology developed by De Koker (2019).

3.1 NRT Methodology

The NRT methodology is a structured and systematic approach to making sense of big data. Developed by De Koker (2019) and further expanded, tested and applied by De Koker and Du Plessis (2024), the NRT methodology allows for data collection and data analysis to take place concurrently. The NRT methodology was adapted from the nominal group technique (NGT), originally developed in the late 1960s by Delbecq and Van de Ven (1971), as a procedure to facilitate effective group decision-making. NGT focuses on humans and group work for decision-making. NRT focuses on the ranking of data, information, and intelligence based on pre-determined criteria for decision-making.

The structured and systematic NRT methodology combines four primary elements. The four primary elements are; 1) Standard of inclusion, 2) Data cleansing linked to the Pareto principle, 3) Relationship of data, information and intelligence linked to the Pareto principle, and 4) VARCS principles. VARCS refer to the validity, accuracy, reliability, credibility, and sufficiency of data, information and intelligence.

The UJ IKM Department SIM BCSs are strategic information management (SIM) business case studies developed by strategic information management professionals, with a focus on the strategic management of information in business.

In order for the NRT methodology to be employed, the researcher had to pre-determine keywords that was used in the ranking of BCSs, in essence the ranking of the data-information-intelligence in the BCSs. The pre-determined keywords emphasise the point by Saunders et al (2016), that "defining explicit rules to code and categorise data in content analysis is important". The pre-determined keywords are further necessary as inclusion criteria, used in the selection process of determining the rank of the BCSs. The pre-determined keywords were: artificial intelligence, business intelligence, business model, business model canvas, commercialisation/ commercialization, competitive intelligence, complex, complexity, complexity science, complexity theory, Cynefin, Cynefin framework, data, decision intelligence, decision-making, ecosystem, fourth industrial revolution, human intelligence, information and knowledge management, information management, information, innovation, intelligence, knowledge management, strategic, strategic information, strategic information management, strategic intelligence, and systems thinking.

The pre-determined keywords stem from the bigger PhD study as mentioned and were specifically pre-determined from the conceptualisation of the PhD study.

4. Results and Discussion

This section addresses the results and discussion of the research paper. The research objective was to introduce and illustrate the structured and systematic approach of the NRT methodology in managing big data. The content analysis in the form of the NRT methodology followed the structured and systematic approach grounded in the four primary elements, discussed below.

4.1 Standard of Inclusion

The standard of inclusion, in the form of inclusion criteria, determines the eligibility of data to be included in the analysis of data to information to intelligence.

4.2 Data Cleansing Linked to the Pareto Principle

Data cleansing ensured that data undergoes a cleaning process for the data to be eligible for inclusion as information through processing, refinement, and analysis, and transformed into intelligence. Data is standardised as per the standard of inclusion to improve the validity, authenticity, reliability, credibility, and sufficiency of the data. The Pareto principle focuses the attention on what may not seem important in the beginning of the NRT methodology in order to arrive at strategic insights in the end.

4.3 Relationship of Data, Information and Intelligence Linked to the Pareto Principle

The NRT must be applied to the cleansed and included data collected from the internal and external business environments to process and refine into information. Afterwards, the data turned information is analysed to produce intelligence. The NRT allows the outcome of the intelligence to be ranked based on importance. The health of the data, information, and intelligence relationship depends on data cleansing, which is a crucial step early in the process of transforming data into information into intelligence.

4.4 VARCS Principles

The VARCS principles ensure that data, information, and intelligence are up to standard in terms of validity, accuracy, reliability, credibility, and sufficiency. They also strengthen the standard of inclusion, data cleansing, and the relationship of data, information, and intelligence.

The NRT methodology is illustrated below in Figure 1.

The NRT methodology with the four primary elements were done prior to the execution of the nominal ranking technique (NRT) on the UJ IKM Department SIM BCSs. The NRT is the ranking of the BCSs and the scoring of the keywords. The results of the NRT of the UJ IKM Department SIM BCSs is illustrated in Table 1. The keyword frequency of the BCSs are illustrated in Figure 2.

5. NRT Methodology Applied

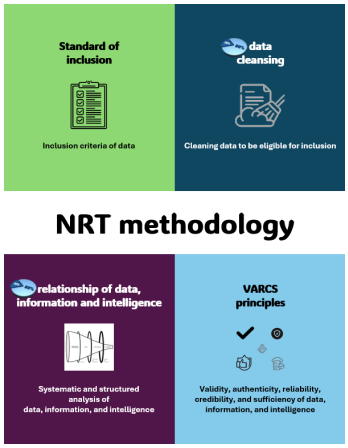


Figure 1: NRT methodology (own source developed for this study, 2025)

The following discusses how the NRT was performed. The sample size of the BCS was *n* = 145. The NRT of the 145 BCSs was done in Microsoft Excel. All the BCSs are stored in the UJ IKM Department SIM BCSs database, which is a standard file repository. The pre-determined keywords were searched for in the 145 BCSs. By doing a standard search of a keyword in the file repository, the researcher could determine which keyword exist in a BCS. An example of a keyword search was as such; a keyword was searched for in the file repository with quotation marks placed around the keyword. The keyword "artificial intelligence" was searched for in the 145 BCSs. Placing quotation marks around the keyword ensured that the search was accurate, as the search engine only returned results that had the entire keyword in the BCSs. This search was deemed relevant, as the results presented the keyword accurately.

Based on the number of times a keyword appeared in the total search of the BCSs, the keyword received a score out of 145. The threshold was set at 145, as it is the number of BCSs that exist. The highest-scored keyword received a score of 124 out of 145. In the case of the keyword "artificial intelligence", the keyword appeared in 22 BCSs, meaning that "artificial intelligence" scored 22. Artificial intelligence ranked 15th out of the 29 pre-determined keywords – shown in Figure 2.

Table 1: Results of the NRT

Results of the NRT					
Ranked – Unsorted			**Ranked – Sorted Highest to Lowest**		
Number	**Business Case Study**	**Rank**	**Number**	**Business Case Study**	**Rank**
1	BCS_1	9	1	BCS_109	17
2	BCS_5	7	2	BCS_169	17
3	BCS_6	14	3	BCS_38	15
4	BCS_8	8	4	BCS_143	15
5	BCS_10	10	5	BCS_6	14
6	BCS_11	11	6	BCS_112	13
7	BCS_12	6	7	BCS_138	13
8	BCS_14	9	8	BCS_45	12
9	BCS_15	11	9	BCS_47	12
10	BCS_16	6	10	BCS_55	12
11	BCS_17	4	11	BCS_72	12
12	BCS_18	9	12	BCS_129	12
13	BCS_20	5	13	BCS_131	12
14	BCS_31	11	14	BCS_132	12
15	BCS_32	5	15	BCS_137	12
16	BCS_38	15	16	BCS_195	12
17	BCS_40	6	17	BCS_203	12
18	BCS_42	11	18	BCS_11	11
19	BCS_43	10	19	BCS_15	11
20	BCS_45	12	20	BCS_31	11
21	BCS_46	9	21	BCS_42	11
22	BCS_47	12	22	BCS_92	11
23	BCS_48	7	23	BCS_99	11
24	BCS_52	0	24	BCS_104	11
25	BCS_55	12	25	BCS_124	11
26	BCS_58	8	26	BCS_135	11
27	BCS_60	10	27	BCS_145	11

Results of the NRT

Ranked – Unsorted			Ranked – Sorted Highest to Lowest		
Number	**Business Case Study**	**Rank**	**Number**	**Business Case Study**	**Rank**
28	BCS_61	8	28	BCS_212	11
29	BCS_63	7	29	BCS_213	11
30	BCS_64	9	30	BCS_10	10
31	BCS_66	1	31	BCS_43	10
32	BCS_67	8	32	BCS_60	10
33	BCS_68	9	33	BCS_70	10
34	BCS_69	3	34	BCS_185	10
35	BCS_70	10	35	BCS_190	10
36	BCS_71	5	36	BCS_194	10
37	BCS_72	12	37	BCS_196	10
38	BCS_74	9	38	BCS_202	10
39	BCS_76	7	39	BCS_220	10
40	BCS_77	6	40	BCS_224	10
41	BCS_78	3	41	BCS_1	9
42	BCS_80	8	42	BCS_14	9
43	BCS_81	7	43	BCS_18	9
44	BCS_82	5	44	BCS_46	9
45	BCS_83	4	45	BCS_64	9
46	BCS_84	5	46	BCS_68	9
47	BCS_85	9	47	BCS_74	9
48	BCS_88	9	48	BCS_85	9
49	BCS_91	8	49	BCS_88	9
50	BCS_92	11	50	BCS_136	9
51	BCS_97	6	51	BCS_157	9
52	BCS_98	2	52	BCS_168	9
53	BCS_99	11	53	BCS_200	9
54	BCS_100	0	54	BCS_211	9
55	BCS_101	6	55	BCS_8	8
56	BCS_102	3	56	BCS_58	8
57	BCS_103	3	57	BCS_61	8
58	BCS_104	11	58	BCS_67	8
59	BCS_105	5	59	BCS_80	8
60	BCS_107	5	60	BCS_91	8
61	BCS_109	17	61	BCS_113	8
62	BCS_110	4	62	BCS_121	8
63	BCS_111	7	63	BCS_122	8
64	BCS_112	13	64	BCS_147	8
65	BCS_113	8	65	BCS_160	8
66	BCS_114	7	66	BCS_179	8
67	BCS_116	6	67	BCS_181	8

Results of the NRT

Ranked – Unsorted

Number	Business Case Study	Rank
68	BCS_121	8
69	BCS_122	8
70	BCS_123	3
71	BCS_124	11
72	BCS_125	5
73	BCS_126	4
74	BCS_127	5
75	BCS_128	7
76	BCS_129	12
77	BCS_130	5
78	BCS_131	12
79	BCS_132	12
80	BCS_133	5
81	BCS_134	6
82	BCS_135	11
83	BCS_136	9
84	BCS_137	12
85	BCS_138	13
86	BCS_139	6
87	BCS_140	4
88	BCS_141	3
89	BCS_142	7
90	BCS_143	15
91	BCS_145	11
92	BCS_147	8
93	BCS_149	7
94	BCS_150	1
95	BCS_151	4
96	BCS_152	2
97	BCS_153	6
98	BCS_154	7
99	BCS_155	3
100	BCS_156	2
101	BCS_157	9
102	BCS_160	8
103	BCS_161	4
104	BCS_162	7
105	BCS_164	7
106	BCS_166	6
107	BCS_168	9

Ranked – Sorted Highest to Lowest

Number	Business Case Study	Rank
68	BCS_186	8
69	BCS_188	8
70	BCS_5	7
71	BCS_48	7
72	BCS_63	7
73	BCS_76	7
74	BCS_81	7
75	BCS_111	7
76	BCS_114	7
77	BCS_128	7
78	BCS_142	7
79	BCS_149	7
80	BCS_154	7
81	BCS_162	7
82	BCS_164	7
83	BCS_183	7
84	BCS_187	7
85	BCS_189	7
86	BCS_198	7
87	BCS_199	7
88	BCS_201	7
89	BCS_210	7
90	BCS_215	7
91	BCS_217	7
92	BCS_223	7
93	BCS_12	6
94	BCS_16	6
95	BCS_40	6
96	BCS_77	6
97	BCS_97	6
98	BCS_101	6
99	BCS_116	6
100	BCS_134	6
101	BCS_139	6
102	BCS_153	6
103	BCS_166	6
104	BCS_175	6
105	BCS_191	6
106	BCS_20	5
107	BCS_32	5

Results of the NRT

Ranked – Unsorted		
Number	**Business Case Study**	**Rank**
108	BCS_169	17
109	BCS_170	3
110	BCS_173	3
111	BCS_175	6
112	BCS_178	4
113	BCS_179	8
114	BCS_180	2
115	BCS_181	8
116	BCS_183	7
117	BCS_184	2
118	BCS_185	10
119	BCS_186	8
120	BCS_187	7
121	BCS_188	8
122	BCS_189	7
123	BCS_190	10
124	BCS_191	6
125	BCS_193	1
126	BCS_194	10
127	BCS_195	12
128	BCS_196	10
129	BCS_197	3
130	BCS_198	7
131	BCS_199	7
132	BCS_200	9
133	BCS_201	7
134	BCS_202	10
135	BCS_203	12
136	BCS_208	5
137	BCS_210	7
138	BCS_211	9
139	BCS_212	11
140	BCS_213	11
141	BCS_215	7
142	BCS_217	7
143	BCS_220	10
144	BCS_223	7
145	BCS_224	10

Ranked – Sorted Highest to Lowest		
Number	**Business Case Study**	**Rank**
108	BCS_71	5
109	BCS_82	5
110	BCS_84	5
111	BCS_105	5
112	BCS_107	5
113	BCS_125	5
114	BCS_127	5
115	BCS_130	5
116	BCS_133	5
117	BCS_208	5
118	BCS_17	4
119	BCS_83	4
120	BCS_110	4
121	BCS_126	4
122	BCS_140	4
123	BCS_151	4
124	BCS_161	4
125	BCS_178	4
126	BCS_69	3
127	BCS_78	3
128	BCS_102	3
129	BCS_103	3
130	BCS_123	3
131	BCS_141	3
132	BCS_155	3
133	BCS_170	3
134	BCS_173	3
135	BCS_197	3
136	BCS_98	2
137	BCS_152	2
138	BCS_156	2
139	BCS_180	2
140	BCS_184	2
141	BCS_66	1
142	BCS_150	1
143	BCS_193	1
144	BCS_52	0
145	BCS_100	0

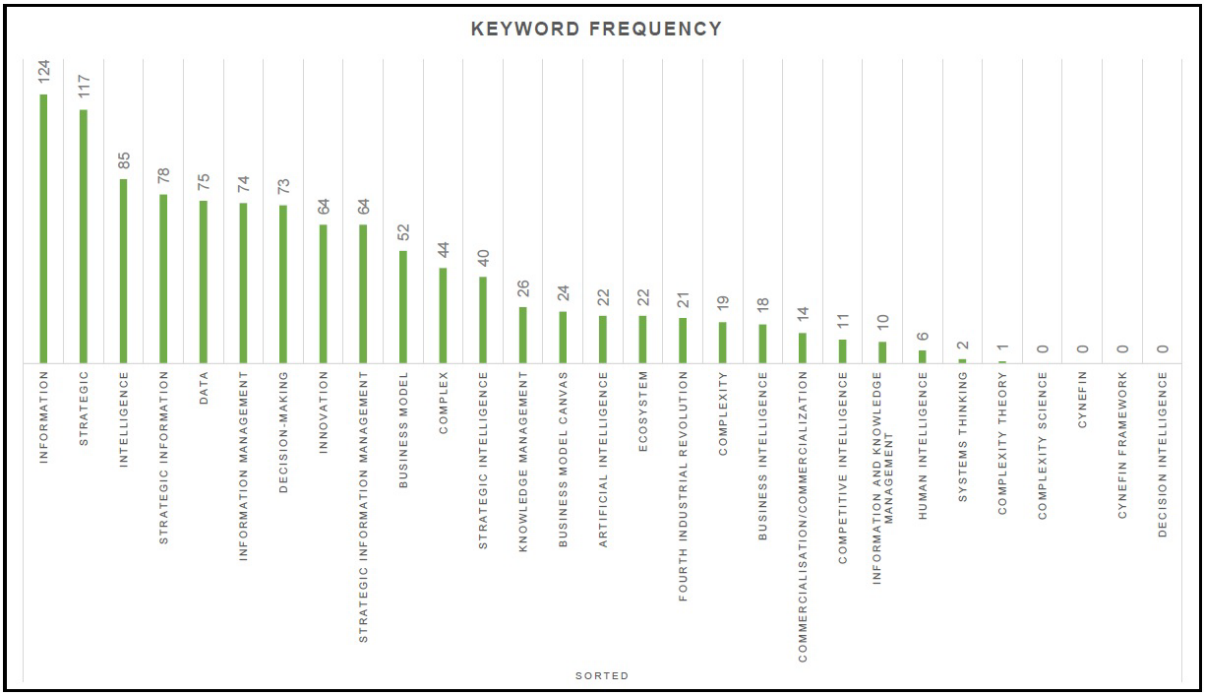


Figure 2: Keyword frequency (own source developed for this study, 2025)

From the NRT conducted on the UJ IKM Department SIM BCSs, the ranking of BCSs illustrated in Table 1 conveys the results of how many keywords were present in a BCS, and how many times a keyword was present in each BCS. Table 1 further illustrates the ranking of BCSs in an unsorted and sorted manner.

Figure 2 illustrates the frequency of the keywords present in the BCSs. The top five keywords that ranked the highest were: 1) information, 2) strategic, 3) intelligence, 4) strategic information, and 5) data. Furthermore, the NRT shows that the interrelated concepts of **data**, **information**, and **intelligence**, which emerged as key aspects in the NRT, are crucial for AI-driven business models. The ranking of **data**, **information**, and **intelligence** reflects that the relationship of data, information, and intelligence – as given in the NRT methodology are central to the management of big data. The presence of the keywords **strategic** and **strategic information** further narrates the level of importance in business. Strategic directly links to executives in the business, relaying that the accurate management of data into information into intelligence is of strategic value to executives for informed decision-making and strategy development. The findings are relevant within the growing data-information-intelligence economy, especially in the context of AI-driven business models. AI-driven business models depend greatly on the ability to process big data, extract into relevant information, and report into actionable intelligence. This in turn informs the strategic direction executives will take. In this context, the strategic deployment of intelligence becomes not only a competitive advantage for a business, but a defining characteristic of businesses in the data-information-intelligence economy.

6. Conclusion

In conclusion, this paper has introduced and illustrated the structured and systematic approach of the NRT methodology for managing big data, demonstrating its potential adaptability within AI-driven business models, that can operate in the data-information-intelligence economy. The necessity for AI-driven business models to effectively manage data for sustainability and competitiveness highlights the importance of a methodology such as the NRT methodology. By emphasizing the structured and systematic approach to the management of data through analysis into information, and subsequently into strategic intelligence, the NRT methodology provides a crucial compass for navigating the complexities of big data management. The principle that unanalysed data and information remain inactive, highlights the value proposition of the NRT methodology, in providing a structured and systematic pathway to generate the intelligence required for sound decision-making. Ultimately, the adoption of such systematic approaches is paramount for AI-driven businesses seeking to thrive in the data-information-intelligence economy, where valid, authentic, reliable, credible, and sufficient data, information, and intelligence are necessitated.

Ethics Declaration

Ethical clearance was obtained from the University of Johannesburg's, College of Business and Economics (CBE) Research Ethics Committee. Ethics clearance for this research was approved on 31 October 2022. Reference number: 2020SCiiS58.

AI Declaration

The authors did not make use of any AI tool in producing this research paper.

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Entrepreneurial Insights From Data to Strategic Intelligence Driving the Sustainable Development Goals

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Abstract: The United Nations Sustainable Development Goals (SDGs) adopted in 2015 provide a basis to address global challenges. The SDGs are aimed at eradicating poverty, protecting the planet, and to ensure prosperity for all. In this context, achieving the SDGs demands innovative solutions in entrepreneurship, particularly within the everchanging volatile, uncertain, complex, and ambiguous (VUCA) world. The emergence and continuous development of technologies such as Artificial Intelligence (AI), Big Data, Blockchain, and Robotics continues to reshape the global landscape, further contributing to the VUCA world. Structured content analysis was done on 50 World Economic Forum (WEF) Strategic Intelligence Topics (SITs) articles. The research findings from the content analysis communicate an insightful message, that the analysed WEF SITs articles resonate towards the importance of strategic - data, information, intelligence, and innovation, for strategic intelligence. This paper underpins the importance of strategic intelligence, in empowering entrepreneurs to effectively navigate the VUCA world to drive impactful growth towards the SDGs. In the VUCA world, entrepreneurs must harness the power of AI to identify emerging opportunities and anticipate potential disruptions, transforming raw data into actionable intelligence. This intelligence translates to strategic decision-making, enabling the development of innovative solutions to address VUCA world challenges, contributing to the attainment of the SDGs. It is crucial that entrepreneurs recognise the challenges of the VUCA world in order for them to contribute meaningfully to achieving the SDGs. Through the message relayed in the 50 WEF SITs articles, it is clear that the VUCA world will continue to accelerate, coupled with the transformative potential of emerging technologies, which presents opportunities for entrepreneurial insights to be achieved, by moving from data to strategic intelligence to drive the SDGs. Finally, this paper emphasises the importance for entrepreneurs to embrace a pre-emptive, agile approach in driving the achievement of the SDGs within the constantly evolving VUCA world, to work towards achieving the SDGs through strategic intelligence.

Keywords: Artificial Intelligence, Emerging Technologies, Entrepreneurship, Strategic Intelligence, Sustainable Development Goals, VUCA

1. Introduction

Achieving the Sustainable Development Goals (SDGs) demands innovative solutions in entrepreneurship, particularly within the everchanging volatile, uncertain, complex, and ambiguous (VUCA) world. In the continuously changing VUCA world, entrepreneurs must be cognisant of the opportunities presented through emerging technologies. A wide variety of technology driven tools assist decision makers to benefit from functional information output, for example, Artificial Intelligence (AI) output. AI potentially engages critical thinkers in the form of insights for strategic decision-making. It is important to note the phrase “potentially engages” because predictive skill and critical thinking differ from person to person and AI to AI. Most people with the assistance of generative AI will make the logical prediction that after Humpty follows Dumpty. The critical thinker is the entrepreneur with the strategic insight that the current market has an appetite for scrambled egg at the exact moment Humpty Dumpty falls. When Humpty Dumpty falls, the critical thinker is the entrepreneur with the foresight of having a heated pan with all ingredients ready and the physical ability to prepare an omelette to serve customers a wholesome meal. On the other hand, the lethargic non-thinker will consume a video of Humpty’s trickery in chocolate egg mythology. In other words, in the VUCA world, entrepreneurs must be critical thinkers with an understanding of real-world functional information.

Functional information quantifies the state of complex systems in numerous different configurations of data transforming it into information and intelligence (Wong et al, 2023). AI has in recent years accelerated the growth of data therefore it is important to investigate opportunities for entrepreneurs to gather meaningful insights. The problem addressed by this paper is the lack of a structured method to aid entrepreneurs to move from data to strategic entrepreneurial insights in the VUCA world. The research question is: What are the steps required to move from data, to information, to intelligence to ultimately assist entrepreneurs to arrive at strategic intelligence?

To answer the research question, this paper presents the findings of the content analysis on 50 WEF SITs articles using the structured and systematic nominal ranking technique (NRT) methodology, which provided valuable

insights. The objective of this research paper is to illuminate how entrepreneurial insights can be gained in the process from data into strategic intelligence, that can be used to drive the SDGs.

2. Entrepreneurial Insights From Data to Strategic Intelligence to Drive the SDGs

Strategic intelligence can be defined as "a systematic and continuous process of producing needed intelligence of strategic value in an actionable form to facilitate long-term decision-making" (Fernández-Villacañas Marín, 2015). Strategic intelligence is about the timely sourcing and efficient management of relevant information (Azzam & Beckmann, 2024). Functional information that is timely sourced and efficiently managed becomes strategic intelligence. In order for entrepreneurs to be actively aware of challenges and opportunities in the VUCA world, requires strategic intelligence.

Many researchers attribute to the world becoming increasingly VUCA: volatile, uncertain, complex, and ambiguous (Wakelin-Theron, Ukpere & Spowart, 2019; Jansen van Vuuren, Visser & Du Plessis, 2022; Salim, Khan, Rahman, Asif, Amin & Khan, 2025). The VUCA world is a result of many rapid changes in the political, environmental, social, and technological spheres (Kruger & Barkhuizen, 2024; Zenk et al, 2024). The challenges and opportunities presented by the VUCA world include to a great extend what is offered by emerging technologies as well as future technologies (Reilly-King, Duggan & Wilner, 2024; Dugoin-Clément, 2024; Manzur et al, 2024). For example, technologies such as blockchain, robotics, and AI for SDGs, have changed the nature and scope of entrepreneurial activity (Chalmers, MacKenzie & Carter, 2021; Salim et al, 2025).

With the uptake and use of AI in almost every industry, the world is currently experiencing the biggest surge of AI interest (Amiri et al, 2024), leading to data growing exponentially. Azzam and Beckmann (2024) further raises the matter of emerging technologies contributing to the volume of unstructured, structured, and qualitative data that must be screened continuously for strategic relevance. Azzam and Beckmann (2024) explains that the extensive growth of data poses severe problems of volume and complexity. Amid these challenges, Sreenivasan, Singh and Suresh (2025) encourages entrepreneurs to innovate through AI.

Through the acceleration of AI, the tremendous growth in data presents opportunities entrepreneurs can tap into and benefit from. AI enables computers to process large unstructured data sets using complex and adaptive algorithms to perform tasks normally requiring human intelligence (Chalmers, MacKenzie & Carter, 2021). The ability of AI to process big data, provide actionable insights, and to automate decision-making processes has changed how traditional businesses and entrepreneurs operate (Ali et al, 2024). With AI being able to leverage big data and learn algorithms to precisely predict phenomena, the big data can be turned into identifying entrepreneurial opportunities for exploitation (Chalmers, MacKenzie & Carter, 2021).

3. Research Methodology

Content analysis on 50 World Economic Forum (WEF) Strategic Intelligence Topics (SITs) articles were employed. The content analysis followed a structured and systematic process named the NRT methodology. The content analysis of the WEF SITs articles for this study was adapted and stemmed from prior research done by De Koker (2019). The NRT methodology was later expanded, tested and applied for purposes of another study by De Koker and Du Plessis (2024). The NRT methodology employed on the 50 WEF SITs articles stem from a PhD study which entailed a much larger content analysis component than can be reported in this research paper. This research paper reports only on a portion aimed at developing a structured method that will aid entrepreneurs to move from data to strategic entrepreneurial insights in the VUCA world. The NRT methodology even though structured and systematic, is flexible and can be adapted to accommodate the needs for the particular research being conducted. It is however important to follow the basic structured and systematic principles of the NRT methodology.

There are four primary elements that constitute the NRT methodology, these are; 1) Standard of inclusion, 2) Data cleansing linked to the Pareto principle, 3) Relationship of data, information and intelligence linked to the Pareto principle, and 4) VARCS principles. VARCS refer to the validity, accuracy, reliability, credibility, and sufficiency of data, information and intelligence. The four primary elements of the NRT methodology form the foundation on which the structured and systematic principles are based. Particularly adapted for the content analysis of the 50 WEF SITs articles, the NRT methodology adhered to the four primary elements. The 50 WEF SITs articles were purposively selected. Purposive sampling was selected as the appropriate sampling technique, which allowed for own judgement to be applied in the selection of the 50 WEF SITs articles (Saunders, Lewis & Thornhill, 2016).

The NRT methodology specifically for the 50 WEF SITs articles followed a seven-step process, distinctively determined to adhere to the four primary principles. The seven-step process was - Step 1: Accessing and selecting the WEF SITs articles, Step 2: Defining WEF SITs articles inclusion criteria, Step 3: NRT WEF SITs articles, Step 4: WEF SITs articles keyword frequency and top 5 keywords, Step 5: Post-NRT WEF SITs articles, Step 6: Strategic Intelligence articles, and Step 7: Strategic Intelligence-Relevant articles. Figure 1 illustrates the seven steps.

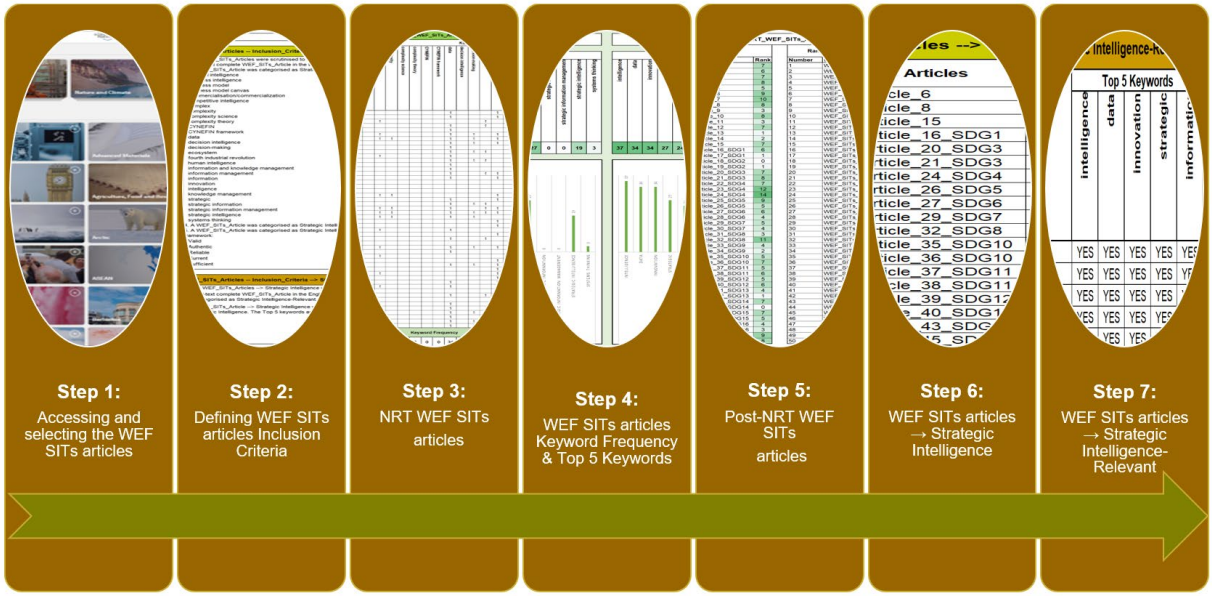


Figure 1: Seven steps of the NRT methodology (own source developed for this study, 2025)

In Step 2: Defining WEF SITs articles inclusion criteria, certain keywords were purposively pre-determined, which stems from the PhD study. The rationale for inclusion and exclusion of WEF SITs articles is justified in relation to the research goals described by De Koker (2025). For the purpose of this paper, as an excerpt of the larger PhD study, the keywords are: (artificial intelligence, business intelligence, business model, business model canvas, commercialisation/commercialization, competitive intelligence, complex, complexity, complexity science, complexity theory, Cynefin, Cynefin framework, data, decision intelligence, decision-making, ecosystem, fourth industrial revolution, human intelligence, information and knowledge management, information management, information, innovation, intelligence, knowledge management, strategic, strategic information, strategic information management, strategic intelligence, and systems thinking). The results and discussion section will further elaborate on the NRT methodology followed for the 50 WEF SITs articles. The NRT methodology demonstrates the steps of functional information that entrepreneurs require to move from data to information, to intelligence.

4. Results and Discussion

The results and discussion section expounds on the seven-step process followed in the distinctive NRT methodology for 50 WEF SITs articles. The 50 WEF SITs articles were found and accessed on the WEF's Strategic Intelligence platform.

4.1 Step 1: Accessing and Selecting the WEF SITs Articles

After access was acquired on the WEF Strategic Intelligence Platform, the WEF SITs articles could be selected. At the time of selecting the WEF SITs articles there were 333 topics on the WEF Strategic Intelligence Platform, in which the articles could be selected. The researcher purposively selected the top 15 WEF SITs articles from the 333 combined topics. The remaining 35 WEF SITs articles were also purposively selected from the SDGs topics on the WEF Strategic Intelligence platform.

4.2 Step 2: Defining WEF SITs Articles Inclusion Criteria

After ensuring access to the WEF Strategic Intelligence platform and ensuring that articles could be selected and downloaded for use, specific inclusion criteria were determined. In the same manner the inclusion criteria were

determined purposively to ensure reliability and validity of the research. Two types of inclusion criteria were determined, namely (1) Strategic Intelligence and (2) Strategic Intelligence-Relevant. The two types of inclusion criteria would help to categorise WEF SITs articles accordingly. Expounded in Step 6 and 7.

4.3 Step 3: NRT WEF SITs Articles

The NRT of the 50 WEF SITs articles determined the top 5 keywords. The top 5 keywords stems from the pre-determined list of keywords mentioned earlier in the Research Methodology section. The NRT WEF SITs articles should not be confused with the NRT methodology of WEF SITs articles. The NRT WEF SITs articles is a step in the entire process of the NRT methodology of WEF SITs articles. In the NRT WEF SITs articles step, the 50 WEF SITs articles that was selected from the WEF Strategic Intelligence platform were scrutinised to determine which of all the keywords mentioned in the Research Methodology section are present in the 50 WEF SITs articles. This leads to the next step, where the top 5 keywords were determined based on ranking scores.

As an example to illustrate Step3: NRT WEF SITs articles - WEF SIT article 1 illustrates the presence of 7 keywords. Therefore, for each keyword found in WEF SIT article 1 the number 1 was assigned, with the keywords found in WEF SIT article 1 being i. Artificial Intelligence, ii. business model, iii. data, iv. Fourth Industrial Revolution, v. innovation, vi. intelligence, and vii. strategic. This is illustrated in Figure 2.

NRT_WEF_SITs_Articles																														
Number	WEF SITs Articles	KEYWORDS																												Rank
		artificial intelligence	business intelligence	business model	business model canvas	commercialisation/commercialization	competitive intelligence	complex	complexity	complexity science	complexity theory	Cynefin	Cynefin framework	data	decision intelligence	decision-making	ecosystem	fourth industrial revolution	human intelligence	information and knowledge management	information management	information	innovation	intelligence	knowledge management	strategic	strategic information	strategic information management	strategic intelligence	systems thinking	
1	WEF_SITs_Article_1	1		1										1				1					1	1		1					7
2	WEF_SITs_Article_2	1												1				1				1	1	1							6
3	WEF_SITs_Article_3	1		1				1									1					1	1	1							7
4	WEF_SITs_Article_4	1		1										1			1					1	1	1		1					8
5	WEF_SITs_Article_5	1												1								1	1	1							5
6	WEF_SITs_Article_6							1						1		1		1				1	1	1		1			1		9
7	WEF_SITs_Article_7	1						1	1					1		1		1	1			1	1	1							10
8	WEF_SITs_Article_8	1												1		1		1					1	1		1			1		8
9	WEF_SITs_Article_9			1										1								1									3
10	WEF_SITs_Article_10	1												1		1	1					1	1	1		1					8
11	WEF_SITs_Article_11							1						1										1							3
12	WEF_SITs_Article_12													1		1	1				1	1	1			1					7
13	WEF_SITs_Article_13													1																	1
14	WEF_SITs_Article_14													1								1									2

Figure 2: NRT WEF SITs articles (own source developed for this study, 2025)

The strategic implications for entrepreneurial practice derived from the WEF SITs articles are linked to the frequent keywords. However, a discussion of the keywords is not the aim of this paper, instead the aim is to identify the steps required to move from data, to information, to intelligence to ultimately assist entrepreneurs to arrive at strategic intelligence.

4.4 Step 4: WEF SITs Articles Keyword Frequency and top 5 Keywords

Figure 3 illustrates the ranking that each keyword tallied up to. The keyword “intelligence” ranked the highest with 37 out of 50, meaning that the keyword “intelligence” is present in 37 WEF SITs articles. The keywords “business model canvas”, “competitive intelligence”, “complexity science”, “complexity theory”, “Cynefin”, “Cynefin framework”, “decision intelligence”, “information and knowledge management”, “strategic information”, and “strategic information management” ranked the lowest with 0 out of 50, meaning that the keywords were not present in any of the 50 WEF SITs articles.

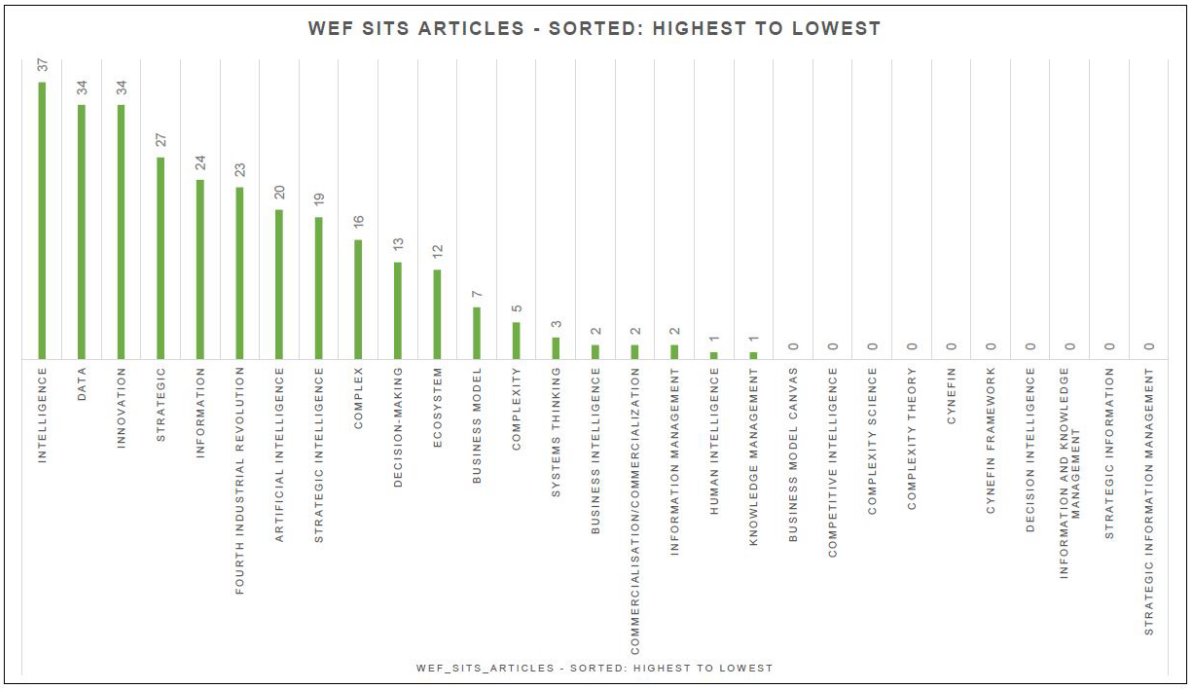


Figure 3: Keyword frequency (own source developed for this study, 2025)

In the 50 WEF SITs articles, it can be interpreted from the top 5 keywords, that the authors mainly focused on the importance of including the keywords - intelligence, data, innovation, strategic, and information. The message behind the top 5 keywords relays the important message that in the 50 WEF SITs articles written by experts from universities, think-tanks, international organisations, and other research institutions that businesses and entrepreneurs are concerned about the strategic nature and use of data, information, and intelligence for strategic decision-making.

4.5 Step 5: Post-NRT WEF SITs Articles

The rank for each of the WEF SITs articles are illustrated in Table 1. The WEF SITs articles are ranked according to how many of the 29 keywords were present in each of the WEF SITs articles.

All the WEF SITs articles had keywords present, except for WEF_SITs_Article_18_SDG2 and WEF_SITs_Article_44_SDG14.

Table 1: Ranked WEF SITs articles

Ranked WEF_SITs_articles					
Ranked - Unsorted			Ranked - Sorted: Highest to Lowest		
Number	WEF_SITs_Articles	Rank	Number	WEF_SITs_Articles	Rank
1	WEF_SITs_Article_1	7	1	WEF_SITs_Article_24_SDG4	14
2	WEF_SITs_Article_2	6	2	WEF_SITs_Article_23_SDG4	12
3	WEF_SITs_Article_3	7	3	WEF_SITs_Article_32_SDG8	11
4	WEF_SITs_Article_4	8	4	WEF_SITs_Article_7	10
5	WEF_SITs_Article_5	5	5	WEF_SITs_Article_6	9
6	WEF_SITs_Article_6	9	6	WEF_SITs_Article_25_SDG5	9
7	WEF_SITs_Article_7	10	7	WEF_SITs_Article_49_SDG17	9
8	WEF_SITs_Article_8	8	8	WEF_SITs_Article_4	8

Ranked WEF_SITs_articles

Ranked - Unsorted

Number	WEF_SITs_Articles	Rank
9	WEF_SITs_Article_9	3
10	WEF_SITs_Article_10	8
11	WEF_SITs_Article_11	3
12	WEF_SITs_Article_12	7
13	WEF_SITs_Article_13	1
14	WEF_SITs_Article_14	2
15	WEF_SITs_Article_15	7
16	WEF_SITs_Article_16_SDG1	6
17	WEF_SITs_Article_17_SDG1	1
18	WEF_SITs_Article_18_SDG2	0
19	WEF_SITs_Article_19_SDG2	1
20	WEF_SITs_Article_20_SDG3	7
21	WEF_SITs_Article_21_SDG3	8
22	WEF_SITs_Article_22_SDG4	7
23	WEF_SITs_Article_23_SDG4	12
24	WEF_SITs_Article_24_SDG4	14
25	WEF_SITs_Article_25_SDG5	9
26	WEF_SITs_Article_26_SDG5	5
27	WEF_SITs_Article_27_SDG6	6
28	WEF_SITs_Article_28_SDG6	4
29	WEF_SITs_Article_29_SDG7	5
30	WEF_SITs_Article_30_SDG7	4
31	WEF_SITs_Article_31_SDG8	3
32	WEF_SITs_Article_32_SDG8	11
33	WEF_SITs_Article_33_SDG9	4
34	WEF_SITs_Article_34_SDG9	2
35	WEF_SITs_Article_35_SDG10	5
36	WEF_SITs_Article_36_SDG10	7
37	WEF_SITs_Article_37_SDG11	5
38	WEF_SITs_Article_38_SDG11	6
39	WEF_SITs_Article_39_SDG12	5
40	WEF_SITs_Article_40_SDG12	6
41	WEF_SITs_Article_41_SDG13	4
42	WEF_SITs_Article_42_SDG13	1
43	WEF_SITs_Article_43_SDG14	7
44	WEF_SITs_Article_44_SDG14	0
45	WEF_SITs_Article_45_SDG15	7
46	WEF_SITs_Article_46_SDG15	5
47	WEF_SITs_Article_47_SDG16	4

Ranked - Sorted: Highest to Lowest

Number	WEF_SITs_Articles	Rank
9	WEF_SITs_Article_8	8
10	WEF_SITs_Article_10	8
11	WEF_SITs_Article_21_SDG3	8
12	WEF_SITs_Article_50_SDG17	8
13	WEF_SITs_Article_1	7
14	WEF_SITs_Article_3	7
15	WEF_SITs_Article_12	7
16	WEF_SITs_Article_15	7
17	WEF_SITs_Article_20_SDG3	7
18	WEF_SITs_Article_22_SDG4	7
19	WEF_SITs_Article_36_SDG10	7
20	WEF_SITs_Article_43_SDG14	7
21	WEF_SITs_Article_45_SDG15	7
22	WEF_SITs_Article_2	6
23	WEF_SITs_Article_16_SDG1	6
24	WEF_SITs_Article_27_SDG6	6
25	WEF_SITs_Article_38_SDG11	6
26	WEF_SITs_Article_40_SDG12	6
27	WEF_SITs_Article_5	5
28	WEF_SITs_Article_26_SDG5	5
29	WEF_SITs_Article_29_SDG7	5
30	WEF_SITs_Article_35_SDG10	5
31	WEF_SITs_Article_37_SDG11	5
32	WEF_SITs_Article_39_SDG12	5
33	WEF_SITs_Article_46_SDG15	5
34	WEF_SITs_Article_28_SDG6	4
35	WEF_SITs_Article_30_SDG7	4
36	WEF_SITs_Article_33_SDG9	4
37	WEF_SITs_Article_41_SDG13	4
38	WEF_SITs_Article_47_SDG16	4
39	WEF_SITs_Article_9	3
40	WEF_SITs_Article_11	3
41	WEF_SITs_Article_31_SDG8	3
42	WEF_SITs_Article_48_SDG16	3
43	WEF_SITs_Article_14	2
44	WEF_SITs_Article_34_SDG9	2
45	WEF_SITs_Article_13	1
46	WEF_SITs_Article_17_SDG1	1
47	WEF_SITs_Article_19_SDG2	1

Ranked WEF_SITs_articles					
Ranked - Unsorted			**Ranked - Sorted: Highest to Lowest**		
Number	**WEF_SITs_Articles**	**Rank**	**Number**	**WEF_SITs_Articles**	**Rank**
48	WEF_SITs_Article_48_SDG16	3	48	WEF_SITs_Article_42_SDG13	1
49	WEF_SITs_Article_49_SDG17	9	49	WEF_SITs_Article_18_SDG2	0
50	WEF_SITs_Article_50_SDG17	8	50	WEF_SITs_Article_44_SDG14	0

4.6 Step 6: Strategic Intelligence Articles

The inclusion criteria for Strategic Intelligence, determined 19 Strategic Intelligence articles from the 50 WEF SITs articles. The inclusion criteria used were:

1. A full-text complete article in the English language, was categorised as Strategic Intelligence.
2. A WEF SITs article was categorised as Strategic Intelligence, if any of the purposively pre-determined keywords mentioned in the Research Methodology section were present in the WEF SITs article.
3. A WEF SITs article was categorised as Strategic Intelligence, if the keyword "Strategic Intelligence" was present in the WEF SITs article.
4. A WEF SITs article was categorised as Strategic Intelligence, if the information in the WEF SITs article exhibited the characteristics of the VARCS framework: Valid, Authentic, Reliable, Current, and Sufficient.

The 19 Strategic Intelligence articles exhibited all the inclusion criteria stipulated here in Step 6 and are illustrated in Table 2.

Table 2: Strategic Intelligence articles

Strategic Intelligence Articles		
Number	**WEF SITs Articles**	**Keyword**
		Strategic Intelligence
1	WEF SITs Article 6	YES
2	WEF SITs Article 8	YES
3	WEF SITs Article 15	YES
4	WEF SITs Article 16 SDG1	YES
5	WEF SITs Article 20 SDG3	YES
6	WEF SITs Article 21 SDG3	YES
7	WEF SITs Article 24 SDG4	YES
8	WEF SITs Article 26 SDG5	YES
9	WEF SITs Article 27 SDG6	YES
10	WEF SITs Article 29 SDG7	YES
11	WEF SITs Article 32 SDG8	YES
12	WEF SITs Article 35 SDG10	YES
13	WEF SITs Article 36 SDG10	YES
14	WEF SITs Article 37 SDG11	YES
15	WEF SITs Article 38 SDG11	YES
16	WEF SITs Article 39 SDG12	YES
17	WEF SITs Article 40 SDG12	YES

Strategic Intelligence Articles		
Number	WEF SITs Articles	Keyword
		Strategic Intelligence
18	WEF SITs Article 43 SDG14	YES
19	WEF SITs Article 45 SDG15	YES

4.7 Step 7: Strategic Intelligence-Relevant Articles

The inclusion criteria for Strategic Intelligence-Relevant, ultimately determined 5 Strategic Intelligence-Relevant articles from the 19 Strategic Intelligence articles. The purposively pre-determined keywords mentioned in the Research Methodology section, played a crucial part in determining the 5 Strategic Intelligence-Relevant articles. The inclusion criteria used were:

1. A full-text complete WEF SITs article in the English language, that exhibits the same characteristics as that of a Strategic Intelligence article, was categorised as a Strategic Intelligence-Relevant article.
2. A Strategic Intelligence article was categorised as a Strategic Intelligence-Relevant article, if the top 5 keywords were present in the Strategic Intelligence article. The top 5 keywords are: intelligence, data, innovation, strategic, and information.

The 5 Strategic Intelligence-Relevant articles exhibited all the inclusion criteria stipulated here in Step 7 and are illustrated in Table 3.

Table 3: Strategic Intelligence-Relevant articles

Strategic Intelligence-Relevant Articles						
Number	WEF SITs articles	Top 5 Keywords				
		intelligence	data	innovation	strategic	Information
1	WEF SITs Article 6	YES	YES	YES	YES	YES
2	WEF SITs Article 21 SDG3	YES	YES	YES	YES	YES
3	WEF SITs Article 24 SDG4	YES	YES	YES	YES	YES
4	WEF SITs Article 32 SDG8	YES	YES	YES	YES	YES
5	WEF SITs Article 45 SDG15	YES	YES	YES	YES	YES

Not only was it important to determine if the articles contained the keyword Strategic Intelligence, the researcher went further to determine whether the top 5 keywords, intelligence, data, innovation, strategic, and information, were indeed present in the Strategic Intelligence articles. The complexity of all the interrelated elements is evident of the VUCA world in which entrepreneurs operate.

This study has practical relevance as to how the findings could inform entrepreneurial decision-making. Firstly, entrepreneurs must conceptualise functional information in the VUCA world. The idea of functional information was introduced in biochemistry in 2003 and has since developed into the general AI principle that systems become increasingly complex over time (Szostak, 2003; Fresco, Ginsburg & Jablonka, 2020; Górriz, et al, 2023; Wong et al, 2023). Secondly, in the complex systems of the VUCA world, the NRT methodology details the steps that are required to move from data, to information, to intelligence to ultimately assist entrepreneurs to arrive at strategic intelligence. The NRT methodology allows entrepreneurs to navigate complex systems that share the following characteristics:

- Diverse interacting components that interact in countless ways.
- Variety of mechanisms for generating numerous configurations of components.

- Multiple selecting for a single function aimed at novelty generation.
- Iterative implementing of feedback loops for continuous improvement.

These characteristics will allow entrepreneurs to persist and explore new spaces that could never be explored before without the assistance of AI. Currently, AI allows for open ended possibilities. Thirdly, from the structured content analysis of 50 WEF SITs articles, the key findings from the top five articles communicate an insightful message that resonates towards the importance of strategic data, information, intelligence, and innovation, for strategic intelligence. This means that entrepreneurship growth can be achieved through:

- Empowering education and learning – by reforming learning approaches for a VUCA world aided by AI agents and tools.
- Innovating in healthcare and social impact – by medical technologies that support intervention at an earlier stage.
- Mobilising resources for environmental sustainability – by transforming industries and urban development.
- Enhancing cultural heritage conservation and investing in creative industries – by prioritising AI skills to combat the phenomenon of AI worship.

Lastly, this study shows that information is a fundamental variable of complexity. Amid the complexity, AI provides opportunities for entrepreneurs to gather meaningful insights and benefit from functional information in the form of insights for entrepreneurial strategic decision-making. Entrepreneurs must be critical thinkers with an understanding of functional information, otherwise they may end up with egg on their face. Entrepreneurs must know that they can break an egg and scramble it, but they cannot unscramble it unless it is an artificial egg. Artificial eggs do not satisfy hungry customers' appetite for wholesome meals. What this means is that human entrepreneurs can see connections, flaws, challenges, threats, and opportunities where AI do not have the real-world insight.

In the years to come, the continuous development of AI, big data, blockchain, and robotics will further shape the entrepreneurial landscape. What the landscape will look like will be determined by the human ability of reasoning, problem-solving, creativity, memory, language and critical thinking. Critical thinking must not deteriorate. These skills form the foundation of the NRT methodology detailing the steps that are required to move from data to information and intelligence to ultimately arrive at strategic intelligence.

5. Conclusion

The objective of this research paper was to illuminate how entrepreneurial insights can be gained in the process from data into strategic intelligence, that can be used to drive the SDGs. The WEF SITs articles particularly on the SDG topic conveys that entrepreneurs can derive insights in the process from data into strategic intelligence. The content analysis of the Strategic Intelligence-Relevant articles narrate that entrepreneurs must be aware of, and embrace the strategic nature and use of data, information, and intelligence for strategic decision-making. This will in turn ensure entrepreneurs are Strategic Intelligence relevant in exploiting key strategic insights from data. Entrepreneurs should embrace the transformative power of AI to derive strategic insights from existing data instead of allowing AI to deteriorate their critical thinking ability. The findings from the WEF SITs articles illustrate that it is possible for entrepreneurs to access data for analysis into strategic insights. By following similar approaches to working with data, such as illustrated and narrated with the NRT methodology, entrepreneurs will be prepared to embrace the challenges and opportunities of the VUCA world to help in driving the SDGs.

Ethics Declaration

Ethical clearance was obtained from the University of Johannesburg's, College of Business and Economics (CBE) Research Ethics Committee. Ethics clearance for this research was approved on 31 October 2022. Reference number: 2020SCiiS58.

AI Declaration

The authors did not make use of any AI tool in producing this research paper.

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Has Social Entrepreneurship Reduced Economic Inequality Among Non-state Actors? A Systematic Review

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Abstract: This paper explores the relationship between social entrepreneurship (SE) and economic inequality, aiming to understand SE's potential in addressing economic disparities among non-state actors. Social entrepreneurship, often recognised for its capacity to create social value and drive social change, offers unique opportunities to tackle pressing societal issues, including economic inequality. By leveraging innovative business models, SE can bridge gaps in income distribution and create sustainable livelihoods for marginalised communities. However, understanding the extent of this impact requires a closer examination of SE's contributions to economic inclusion and equity. Through a systematic literature review, as well as a bibliometric and content analysis of the selected studies, this paper investigates the growing body of research on SE, identifying key themes, trends, and research gaps. The analysis reveals a global interest in SE, as evidenced by an increasing number of publications over the past two and a half decades. This rise in academic attention reflects the recognition of SE's potential to address various social challenges. Despite this progress, the direct relationship between SE and economic inequality remains underexplored. Most research has focused on SE's social impact—such as community development, poverty alleviation, and environmental sustainability—rather than its economic implications. The paper also identifies core concepts associated with SE, including social entrepreneur, social enterprise, social innovation, social capital, economic development, work and employment, and sustainable entrepreneurship. However, references to economic inequality are often implicit rather than explicit, highlighting a gap in the literature. This suggests a need for more focused research that examines how SE can effectively reduce economic disparities, particularly through income redistribution, wealth creation, and access to economic opportunities for marginalised communities. Whilst SE has the potential to be a powerful tool for reducing economic inequality, realising this potential requires addressing persistent challenges. Among these challenges is the widening gap between low- and high-income sectors, which complicates SE interventions and limits their transformative impact.

Keywords: Economic Equality, Income Equality, Social Capital, Social Enterprise, Social Entrepreneurship, Social Innovation

1. Introduction

Interest in the concept of social entrepreneurship (SE) has been rising in the last 25 years. A cursory search in the electronic database Scopus on the keyword *social entrepreneurship* will generate a result exhibiting a steady increase in the number of documents indexed between the years 2000 and 2024 (see Figure 1). This upward trend is expected to continue overtime.

The growing interest in SE may be attributed to its dual benefits: harnessing the positive effects of entrepreneurship whilst generating meaningful social impact within communities. It is the form of entrepreneurship that serves as an impetus for economic growth and social change (Pathak & Muralidharan, 2018). The myriad benefits of entrepreneurship, both financial and non-financial, to the individual and the society are well established (Luke et al., 2007). By integrating traditional entrepreneurship with social principles to tackle pressing social issues such as unequal wealth distribution and income inequality, the potential for inclusive benefits is greatly enhanced.

Current extant research is focused on the factors that drive an individual to become a social entrepreneur (Pathak & Muralidharan, 2018). Bozhikin et al. (2019), for instance, defined these drivers as "(i) social inclusion and social economy, (ii) SE and economic development, and (iii) networks and social innovation" (p. 736).

Meanwhile, other studies are focused on the role of government and key non-state actors in promoting or facilitating SE in developing countries (Bozhikin et al., 2019). However, limited research exists on the direct relationship between SE and economic inequality.

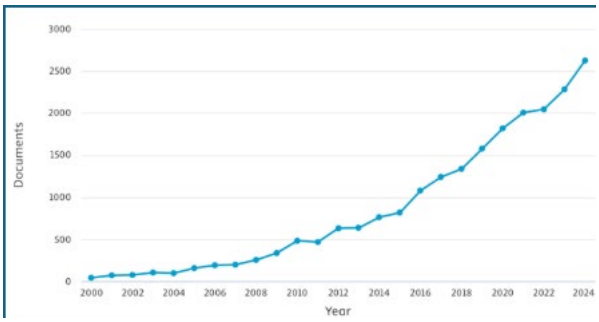


Figure 1: Number of documents related to 'social entrepreneurship' and indexed by year in Scopus

One study examining the link between SE and economic inequality involved a total of 77,983 individual responses sourced from the Global Entrepreneurship Monitor data across 26 countries, and similar country-level data retrieved from the Global Competitiveness Report by the World Economic Forum (Pathak & Muralidharan, 2018). The study found that income inequality increases the likelihood of SE under conditions of low-income mobility (Pathak & Muralidharan, 2018). Whilst it is one of few studies that found a link between economic inequality and SE, other contextual factors that did not surface from the study deserve an exploration. Our study therefore aims to expand their findings by determining other conditions that can connect economic inequality with SE using data from extant literature.

There is no consensus on the exact definition of SE. Some scholars have defined SE as an activity where business principles are adopted by non-business entities such as governments and not-for-profits in their operations (Bozhikin et al., 2019). Nonetheless, SE has been adopted in corporate social responsibility and philanthropy programmes of private-sector business enterprises (Bozhikin et al., 2019). Additionally, it has also made its way to social innovation studies (Bozhikin et al., 2019). Other definitions are related to the method and approach adopted by SE in solving social problems such as poverty and environmental degradation (Bozhikin et al., 2019; Pathak & Muralidharan, 2018). For the purposes of our study, we define SE in the context of traditional entrepreneurship; that is, it is a business or commercial activity whose financial benefits redound to a community or a marginalised sector of the society.

Meanwhile, economic inequality is described in literature as a disparity among citizens in terms of their wealth and income (Pathak & Muralidharan, 2018). The role of traditional entrepreneurship on income inequality has been investigated in a study covering data from 47 developing countries from 2009 to 2017 (Mohamad et al., 2021). Theoretically, if citizens, especially the poor and the marginalised, practice entrepreneurship, the country will experience less income inequality (Mohamad et al., 2021). Overall, the study confirmed that increasing entrepreneurship activities will decrease incidents of income inequality in developing countries (Mohamad et al., 2021).

There have been a few studies linking entrepreneurship with income inequality. Two of them find themselves in disagreement. The Swedish study (Halvarsson et al., 2018) observed that entrepreneurship increases income inequality. Self-employment widens the gap in terms of income amongst the poor whilst incorporated entrepreneurship seems to increase the dispersion among the rich (Halvarsson et al., 2018). On the other hand, the Ethiopian study (Kimhi, 2010) concluded that entrepreneurship helps reduce income inequality altogether.

This paper seeks to answer the question: *To what extent has SE contributed to reducing economic inequality among non-state actors?* While previous studies have explored the social impact of SE, this paper contributes to the literature by systematically analysing empirical studies that explore or imply SE's influence on economic inequality. It addresses a notable gap by focusing explicitly on economic dimensions such as income redistribution, employment generation, and financial inclusion, which are often overlooked in SE research.

2. Materials and Methods

Our study draws from data available from Elsevier's Scopus which was selected from other similar databases and platforms for its comprehensive list and quality entries (Falagas et al., 2008; Gudanowska, 2017; Mingers & Meyer, 2017). The methodology used for this research was systematic review of literature, which is regarded

as a rigorous approach to literature review for its objectivity, transparency, and replicability (Torgerson, 2003). Compared to narrative literature review, the systematic review approach can reduce bias and provides a more extensive analysis of extant knowledge (Bozhikin et al., 2019; Torgerson, 2003).

On 03 April 2025, the following search keywords were typed in the search engine of Scopus: *social entrepreneurship, social enterprise, social innovation, cooperative entrepreneurship, economic inequality,* and *economic equality*. The search was limited to publication years before 1999, or 2000 onwards. The reason for the selection of this period was the observed rise in the interest in SE, which started in the 2000s (see Figure 1). The same trend was detected in a related systematic literature review (Bozhikin et al., 2019), which informed and inspired this study.

The initial query generated a total of 2,062 documents in the Scopus database. To further refine our search, we added filters to find journal articles only. This was to ensure that only scholarly works were included in this systematic review. The outcome was further filtered out to obtain papers in the English language only. This surfaced a total of 1,041 studies.

The preliminary results were screened to remove conceptual papers, those not related to this research, and others that were inaccessible. The final screening resulted in a total of 53 empirical studies that would comprise the data sample for this analysis. The search methodology employed in this systematic review is reflected in the schema shown in Figure 2.

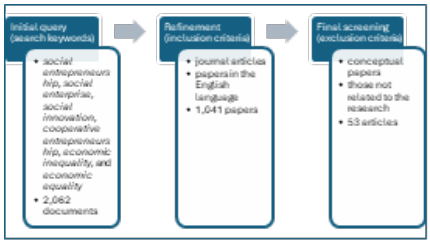


Figure 2: Schema of the search methodology used to obtain the data sample

To minimise selection bias, two reviewers independently screened titles and abstracts using the predefined inclusion criteria. Disagreements were resolved through discussion and, when necessary, consultation with a third reviewer. The final coding of included studies followed a structured template to ensure consistency in extracting data on SE dimensions and economic impacts.

3. Results

An analysis of the bibliometric data from the sample of papers using the bibliometric visualiser software VOSviewer indicates that the following words frequently occur in the text: *entrepreneurship, social entrepreneur, social innovation, social enterprise, social capital and economic development,* and *sustainable entrepreneurship*. They are presented in the diagram with large fonts and different colours (see Figure 3). Other minor or less recurring words are *relationship*, *work, employment, implementation,* and *Morocco.* Notably, there were no specific references made in relation to the original search keywords *economic inequality* or *economic equality*. This indicates that studies related to the link between SE and economic inequality are scarce.

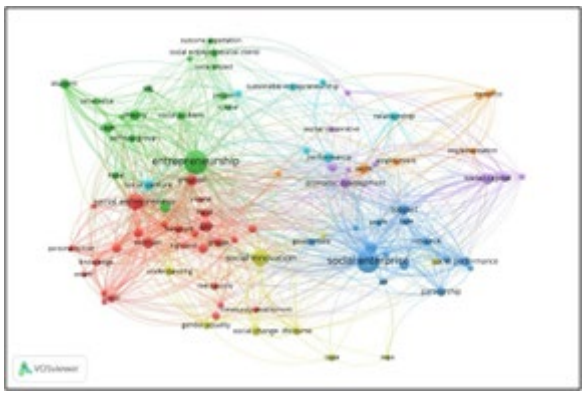


Figure 3: Network diagram of frequently occurring words from the data sample

3.1 The Social Entrepreneur

The first concept is focused on the individual, more specifically on the traits of social entrepreneurs. Several studies (e.g., Bernardino et al., 2018; Clark Muntean & Ozkazanc-Pan, 2016; Fernández et al., 2024; Hayhurst, 2014; Kawarazuka et al., 2023; E. Kim, 2023; Kumari & Eguruze, 2022; Lauri, 2021; Maguirre et al., 2016; Nsereko et al., 2021; Siqueira et al., 2023) discussed gender equality within the context of SE. The reason for the multitude of SE studies dedicated to gender equality is that it is a common view that SE is a valuable tool to solve the world's social issues, including gender inequality (Bozhikin et al., 2019).

Other studies focused on the individual traits, which are anchored on the general concept of traditional entrepreneurship as can be deduced from Figure 3. Broccia et al. (2022) related the direct and indirect effects of innovativeness with entrepreneurial and social entrepreneurial self-efficacy in the light of organisational capabilities and philanthropic corporate social responsibility. Lee et al. (2022) examined the role of social recognition in the motivational dynamics of social entrepreneurial intention. Mouraviev and Kakabadse (2022) studied the role of social entrepreneurs' cosmopolitan orientation in bridging the gap between prosperity and social deprivation whilst Choi and Chang (2020) applied the human capital theory to link social entrepreneurs' characteristics with the performance of social ventures.

3.2 The Social Enterprise

The second concept that emerged from this systematic review of literature related to SE deals with the social enterprise itself. Oloke (2024) examined the perspectives of individuals managing social enterprises and found that these organisations contribute to transforming unequal social structures to varying degrees. This impact occurs regardless of whether their work is perceived as significantly changing the situation (transformative) or addressing deficiencies (compensatory) (Oloke, 2024). Kajiita and Kang'ethe (2023) support this view, describing social enterprises as mechanisms for addressing social challenges.

Related to these studies is the work of Musinguzi et al. (2023), which examined the interrelationships between internal factors (e.g., business planning), external factors (e.g., financial and training support), and critical success factors in the performance of rural social enterprises. A similar study by Segovia-Vargas et al. (2024), analysed the factors influencing the survival or failure of social enterprises. Additionally, Wang and Ni (2023) studied the impact of internet connectivity on the productivity of rural enterprises whilst Cucchi et al. (2022) explored how social enterprises helped ease tensions within communities with fixed sets of beliefs, norms and customs. Similarly, the study of D'alessio et al. (2024) focused on the cultural dimensions surrounding social enterprise models by comparing findings between Italy and Romania.

3.3 Social Innovation

The third concept that surfaced from this systematic review concerns social innovation that arises from SE. Slee (2019) defines social innovation as any novelty of practice performed by the civil society. In his paper he presents the different types of social innovation as practiced in rural Scotland (Slee, 2019). Meanwhile, Olloqui et al. (2023), found that technological innovations are necessary to foster social innovation. Further, there is a need for public-private partnerships to facilitate social innovation, and focusing efforts on social innovation is significant for attracting development and investments (Olloqui et al., 2023).

3.4 Social Capital and Economic Development

Most papers from this systematic review were related to social capital and economic development. Specifically, these papers (Barinaga, 2013; Choi et al., 2018; Gordon et al., 2018; Michele, 2021; Montgomery et al., 2008; Mulyono et al., 2020; Nurlanova et al., 2023; Pathak & Muralidharan, 2018; Pothipala et al., 2021; Sangvikar et al., 2019; Singh et al., 2023; Van Trung, 2021) discussed how SE contributed to the socioeconomic development of societies and communities. Siqueira et al. (2023) extended this socioeconomic development to include environmental change. Further, the research conducted by Okutayeva et al. (2024) was among the studies that highlighted the important contribution of social entrepreneurship in reducing inequalities and promoting sustainable development by solving social issues. Related to this study was that of Assaf (2024), which found strong links between financial inclusion strategies, among others, and women's empowerment. Nonetheless, the study of Seferiadis et al. (2023) found that SE yielded insignificant benefits for young social entrepreneurs in Ghana.

Whilst these papers discuss the effects of SE on economic development, a few studies from this systematic review reveal the opposite: the impact of economic development on social enterprises. For instance, Leitner et al. (2023) examined how residents of peri-urban settlements respond to unexpected developments and manage the uncertainties arising from market-induced displacement. They found that large-scale planned developments and infrastructure projects lead to widespread displacement of residents and the disappearance of agricultural fields, vegetable plots, and small enterprises (Leitner et al., 2023).

3.5 Implementation of SE and its Effect on Work and Employment

A few studies illustrated the implementation of SE and its effect on work and employment. One research (E. Kim, 2023) explored a project that involved conducting a product innovation and management course in a social enterprise by a university. Mychajluk (2023) analysed the role of the learning environment and the interactions within ecovillages as far as learning outcomes and processes are concerned. Nsereko (2021) highlighted the case of social entrepreneur Dr Moses Musaazi, the former managing director of social enterprise T4T, which manufactured low-cost sanitary napkins for teenage girls stigmatised because of their menstrual periods. Additionally, Pérotin (2006)examined the determinants of entry and exit between workers in cooperatives and conventional firms whilst Simanaviciene et al. (2017) compared social business models in Lithuania, Italy and Great Britain.

3.6 Sustainable Entrepreneurship

Lastly, several papers in this systematic review addressed the concept of sustainable entrepreneurship, another dimension of SE. Calvo et al. (2020) focused on upcycling-based social and creative enterprises. Similarly, Fernández et al. (2024) highlighted the gendered and socioenvironmental effects of seaweed production, noting its connections to the global market and susceptibility to market fluctuations.

Vázquez-Maguirre (2020) analysed how indigenous social enterprises contribute to building sustainable rural communities. Vieira et al. (2019) examined the transformative potential of food-producing social enterprises in their efforts to create sustainable and resilient urban food systems. McQuilten (2017) explored the potential role of art- and fashion-based social enterprises in contributing to sustainable community development whilst also fostering critique and political engagement within contemporary capitalism. Popkova et al. (2023) focused on the post-COVID 19 pandemic perspective of SE in relation to sustainable development.

4. Discussion

Whilst this study confirms the effectiveness of SE in reducing economic inequality, it also found several significant challenges to reduce economic inequality through SE. One key difficulty is the need to effectively serve disadvantaged groups, who often lack access to resources and opportunities, making it challenging for SE initiatives to reach and support them adequately (Oloke, 2024). Further, existing social development interventions within countries are frequently ineffective, necessitating SE to address these shortcomings, which can be complex and resource-intensive (Kajiita & Kang'ethe, 2023).

The gap between high- and low-income groups continues to widen, further entrenching economic inequality and making it harder for SE to bridge this divide (Mouraviev & Kakabadse, 2022). High levels of wealth inequality, combined with an ingrained patronage culture, create environments where SE struggles to gain traction and achieve its goals (Pothipala et al., 2021). The lack of social awareness and the low operational efficiency of some social enterprises further hinder their effectiveness in tackling economic inequality (Pothipala et al., 2021). Issues like failing food systems and significant health inequalities present additional barriers, as SE must navigate these complex social problems whilst attempting to reduce economic disparities (Gordon et al., 2018; Vieira et al., 2019). Finally, the lack of opportunities in local communities and the pervasive economic inequality within these areas pose significant obstacles to SE's success (Mulyono et al., 2020).

5. Conclusion

Whilst SE is often associated with concepts such as social entrepreneur, social enterprise, social innovation, social capital, economic development, work and employment, and sustainable entrepreneurship, the direct connection to economic inequality is not as prominent. This finding suggests that the discourse around SE has predominantly focused on its social impact rather than its economic implications. The absence of economic

inequality as a frequently occurring theme in the literature highlights a significant gap that future research should aim to address.

The limited research directly linking SE to economic inequality calls for more focused studies that examine the conditions under which SE can effectively narrow economic disparities. Additionally, there is a need for more empirical research that measures the economic outcomes of SE initiatives, particularly in terms of income redistribution and wealth creation among marginalised communities. Policymakers and practitioners should consider the challenges when designing and implementing SE initiatives to ensure that they contribute meaningfully to economic inclusion and equity.

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Ethics Declaration

This study did not involve human participants, personal data, or any form of intervention or interaction with individuals. As such, it did not fall within the scope of research requiring ethics review and clearance. Therefore, approval from an ethics review board was not sought nor required for the conduct of this research.

AI Declaration

An AI tool, ChatGPT by OpenAI, was used during the development of this paper solely for the purpose of checking grammar and ensuring consistency in the text. The content, analysis, and conclusions presented herein are entirely the work of the authors.

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Geopolitical Risks: Threats or Opportunities in Shaping Entrepreneurial Intentions?

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Abstract: Geopolitical risks have intensified globally, creating both challenges and opportunities for entrepreneurs. This study examines the impact of geopolitical risk on entrepreneurial intentions using the Theory of Planned Behaviour (TPB) as a framework. Through an analysis of attitudes, subjective norms, and perceived behavioural control, this research seeks to understand how individuals perceive and navigate uncertainty in a volatile global landscape. The focus of the study is specifically on young entrepreneurs and business students in Cyprus, a region of strategic geopolitical importance situated at the crossroads of Europe, Asia, and the Middle East. A qualitative methodology was employed, utilizing focus groups to capture insights into how geopolitical risks influence entrepreneurial decision-making. The findings reveal that geopolitical risks impact entrepreneurship by reshaping market conditions, altering access to resources, and driving innovation in response to uncertainty. While geopolitical turbulence creates barriers such as supply chain disruptions, inflationary pressures, and investment uncertainty, it also generates opportunities, particularly in technology-driven sectors. Attitudes toward risk and resilience, social expectations, and perceived control over external challenges play a crucial role in shaping entrepreneurial intentions. The study contributes to the understanding of entrepreneurship in unstable environments and provides insights for policymakers and business educators on fostering resilience and opportunity recognition in high-risk contexts.

Keywords: Geopolitical Risk; Entrepreneurial Intention; Theory of Planned Behaviour (TPB); Technological Innovation; Geopolitical Uncertainty; Cyprus

1. Introduction

In recent years, geopolitical risks—including armed conflicts, trade wars, and disputes over natural resources—have escalated on a global scale. The rise of populism, political fragmentation, and violence in both developed and developing nations has created an environment of heightened political and economic uncertainty for businesses (Sinani & Zilja, 2024). These disruptions are reshaping the global entrepreneurial landscape, affecting supply chains (Zheng & Gong, 2024; Roscoe et al., 2022), altering market accessibility, and transforming regulatory frameworks. Nevertheless, amidst these challenges, geopolitical turbulence can also catalyse innovation and generate new opportunities (Krasteva & Yildirim, 2016). It is therefore imperative to understand how entrepreneurs perceive and navigate these challenges, particularly in an era of growing global instability.

Despite the considerable interest in academic research on geopolitical risk, examining its influence on different aspects such as the digital economy (Zheng and Gong, 2024), corporate innovation (Lee et al., 2023), global supply chains (Deirmentzoglou, 2025), and energy security (Deirmentzoglou et al., 2024a), there has been a paucity of research on how geopolitical risk influences entrepreneurial intentions. In order to address this research gap, the present study employs the Theory of Planned Behaviour (TPB) developed by Ajzen (1991) to analyse how individuals' attitudes, subjective norms, and perceived behavioural control regarding entrepreneurship are affected by geopolitical risk. While prior studies have examined the impact of economic and institutional factors on entrepreneurship, there has been less focus on how geopolitical uncertainty influences entrepreneurial intentions and actions. By employing the TPB framework, this study aims to offer a more nuanced understanding of how entrepreneurs perceive and respond to geopolitical challenges.

To explore these dynamics, the research focuses on business students and young entrepreneurs in Cyprus, a country with a strategic geopolitical position (Savvides, 2015) at the intersection of Europe, Asia, and the Middle East. Historically, Cyprus has played a pivotal role in international trade, diplomacy, and economic activity, which positions it as an ideal setting to analyse how entrepreneurs in geopolitically sensitive regions navigate uncertainty and risk.

This paper is structured as follows: Section 2 introduces the concept of geopolitical risk and reviews recent studies on its implications. Additionally, the TPB, which serves as the central framework for this study, is discussed. Section 3 outlines the methodology employed, specifically the focus group approach used to gather data. The main findings of the study are presented in Section 4, followed by a discussion of these findings in

Section 5. Finally, Section 6 highlights the theoretical and practical implications of the study, while also addressing its limitations and offering directions for future research.

2. Literature Review

2.1 Geopolitical Risk

The contemporary world is on the cusp of a new era of global disorder, characterized by mounting volatility and unpredictability. This period of turbulence is marked by the emergence of geopolitical fractures, the rise of unilateral nationalistic policies, and the resurgence of trade protectionism. This transition signifies a deviation from the traditional multilateral governance model, propelling the global landscape towards a more nationalistic and interventionist environment (Luo, 2024). Consequently, entrepreneurs operating in international markets must navigate an environment with high levels of geopolitical risk. Geopolitical risk, a subset of political risk, is defined as *"the threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political actors that affect the peaceful course of international relations"* (Caldara and Iacoviello, 2022).

Innovation is a foundational element of business success and entrepreneurship, propelling growth and competitiveness (Agoraki et al., 2024a). In the face of mounting challenges, the role of innovation becomes increasingly critical for ensuring long-term sustainability (Agoraki et al., 2024b; Pistikou et al., 2023). The relationship between geopolitical risk and innovation has been the subject of extensive research, which has revealed a complex dynamic. On one hand, innovation enables firms to maintain their competitive edge, even in the face of challenges posed by geopolitical risk to investment (Aghion et al., 2005). In certain instances, heightened uncertainty can prompt firms to increase investment in innovation to take advantage of new growth opportunities and strengthen their market position (Krasteva & Yildirim, 2016). Furthermore, in the context of economic policy uncertainty, companies may reallocate their investment portfolios, shifting from physical investments to corporate innovation (Ross et al., 2018). Conversely, excessive geopolitical risk can create an overwhelming level of uncertainty, leading to sunk costs and reducing firms' long-term innovation efforts. Lee et al. (2023) further posit that the relationship between geopolitical risk and innovation can be detrimental, as it raises external financing costs and diminishes the ability of firms to raise capital, ultimately hindering their capacity for innovation.

Digital technologies have become critical drivers of entrepreneurship, profoundly reshaping various industries (e.g. Deirmentzoglou et al., 2024; Kourkoumelis et al., 2024) and generating new opportunities for growth, efficiency, and global collaboration. Nevertheless, geopolitical risk presents considerable challenges to the digital economy, thereby disrupting its growth and stability. As Zheng and Gong (2024) emphasize, geopolitical risk gives rise to trade barriers, sanctions, and technology restrictions that impede market access and international cooperation. Furthermore, elevated financial uncertainty has been shown to discourage investment in digital projects, while the growing threat of cyber-attacks and data breaches puts critical infrastructure at risk and undermines public trust in digital platforms (Akoto, 2021). Furthermore, Alsagr et al. (2023) argue that geopolitical risks negatively impact the success rates of crowdfunding initiatives, demonstrating how external instability can undermine the potential for digital ventures to thrive.

Kannadhasan and Das' (2020) recent study indicates that the impact of geopolitical risk on markets is sector-dependent. While certain industries encounter downturns, others exhibit growth during periods of geopolitical turbulence. Sectors such as defence, telecommunications, and utilities (e.g., water supply) often see rising demand during crises, driving up prices. Conversely, industries such as leisure, hospitality, and airlines are more likely to suffer as geopolitical disruptions reduce consumer confidence and travel demand.

2.2 Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB), developed by Ajzen (1991), is a framework that seeks to explain and predict human behaviour through three core components: attitude, subjective norm, and perceived behavioural control. According to the theory, attitude refers to an individual's positive or negative evaluation of performing a particular behaviour. Subjective norm, in turn, pertains to the social pressure individuals perceive regarding whether or not they should engage in a specific behaviour, influenced by the expectations of important others (e.g., family, friends, or colleagues). Finally, perceived behavioural control reflects an individual's belief in their ability to perform the behaviour, which may be influenced by factors such as external constraints or self-efficacy.

The TPB posits that these three components collectively shape the intention to perform a behaviour, which in turn predicts the actual behaviour.

The TPB has been extensively used in research on entrepreneurial intentions (e.g., Maheshwari, 2021; Farrukh et al., 2019; Maes et al., 2014; Kibler, 2013; Krueger and Carsrud, 1993). Consequently, it is the most suitable framework to explore entrepreneurial intentions in the context of geopolitical risks. In the present study, attitudes are understood to reflect how entrepreneurs assess geopolitical risks as either threats or opportunities. Subjective norms are defined as the influence of social and cultural expectations on entrepreneurial decision-making. Perceived behavioural control is understood to determine whether entrepreneurs feel capable of navigating geopolitical uncertainties.

3. Methodology

This study employs a qualitative research approach to explore how geopolitical risk influences entrepreneurial intentions through the lens of the Theory of Planned Behaviour (TPB). Given the complex and evolving nature of geopolitical risk, qualitative methods provide rich insights into individuals' perceptions, attitudes, and decision-making processes. To this end, we conducted two focus groups with business students and young entrepreneurs in Cyprus, a country with a strategic geopolitical position at the intersection of Europe, Asia, and the Middle East.

Focus groups were selected as the primary data collection method to promote in-depth discussions on the impact of geopolitical risks on entrepreneurship. The utilization of focus groups as a primary data collection method is a well-established technique in the realm of social research, as evidenced by its widespread application and the accumulation of substantial evidence regarding its efficacy (Wilkinson, 1998). This method has been demonstrated to yield insights into the spectrum of ideas and sentiments held by individuals concerning various issues (Rabiee, 2004). The method allows for the exploration of collective perceptions, enabling participants to reflect on shared experiences and engage in dynamic exchanges that reveal underlying motivations, concerns, and coping strategies. The focus groups were designed to examine how attitudes, subjective norms, and perceived behavioural control—the key components of TPB—are shaped by geopolitical risk.

The study recruited business students and young entrepreneurs from Cyprus, reflecting two groups highly relevant to entrepreneurial research. Business students represent the next generation of entrepreneurs, while young entrepreneurs provide firsthand experience of operating ventures under geopolitical instability. Participants were selected through purposive sampling, ensuring diversity in backgrounds, experiences, and perspectives. The final sample consisted of eight participants in each of the two focus group with a balance of students and entrepreneurs.

The focus groups were conducted in a semi-structured format, with each session lasting approximately 90 minutes. One of the study's authors served as the moderator, overseeing the discussions and posing a predetermined series of open-ended questions to ensure that participants addressed key issues while allowing for flexibility in responses. Following the transcription of the discussions, the initial codes were generated and subsequently organized into the research themes.

4. Findings

The discussions with the two focus groups explored how geopolitical risks influence entrepreneurial intentions through the Theory of Planned Behavior (TPB) framework. Participants expressed both concerns and optimism regarding global uncertainties such as wars, energy crises, trade tariffs, and digital transformation. While some viewed these challenges as barriers to entrepreneurship, others identified opportunities emerging from disruptions, particularly in technology-driven sectors. The findings suggest that geopolitical risks pose both challenges and strategic openings for entrepreneurs, with success depending on adaptability, innovation, and access to supportive networks.

4.1 Attitudes Toward Entrepreneurship in a Geopolitically Uncertain Environment

Participants widely acknowledged that geopolitical instability shapes the entrepreneurial landscape, with mixed views on whether it helps or hinders business creation. While some saw global crises as significant obstacles, others saw new opportunities arising from disruption.

4.1.1 Geopolitical Risks as Barriers

Several participants pointed to the war in Ukraine, the ongoing Israeli-Palestinian conflict, and rising tensions in other regions, highlighting their impact on supply chains, inflation, and investor confidence. The European energy crisis was of particular concern, as rising operating costs and reduced consumer purchasing power put additional pressure on businesses. In addition, shifting trade policies, such as increased U.S. tariffs on European goods, created uncertainty for those looking to expand internationally. This instability also disrupted access to critical digital infrastructure, impacting cloud services, cybersecurity resilience, and cross-border e-commerce operations. For instance, one of the participants stated:

"Rising energy prices and inflation make business planning much more difficult. The cost of raw materials, logistics, and even digital infrastructure has gone up."

4.1.2 Turning Crisis into Opportunity

On the other hand, several participants emphasized that geopolitical uncertainty often drives innovation and opens new markets. For example, the Russo-Ukrainian war has accelerated demand for renewable energy solutions, while AI-driven technologies are enabling companies to more effectively manage supply chain disruptions. E-commerce platforms have also allowed businesses to reach global markets despite regional instability, providing alternative revenue streams. Some entrepreneurs saw these shifts as opportunities to invest in green technology, fintech, and digital services, leveraging AI and blockchain to improve security and operational efficiency. As one participant mentioned:

"*As energy security becomes a priority, there's a growing market for startups in renewable energy and energy efficiency technology. Similarly, AI-powered analytics and digital marketplaces are helping companies adapt to supply chain challenges."*

Ultimately, these findings suggest that attitudes toward geopolitical risk depend on an entrepreneur's ability to recognize and act on emerging opportunities. While instability poses challenges, those who adapt and innovate - particularly through digital transformation - can find strategic openings in shifting global markets.

4.2 Subjective Norms: The Role of Society and Networks

Social and professional networks play a critical role in shaping risk perceptions and entrepreneurial behavior. Participants shared experiences of both discouraging and encouraging influences from their social circles, educational institutions, and business ecosystems.

4.2.1 Risk-aversion in Career Choices

Many participants noted that in an uncertain geopolitical climate, families and institutions often discourage entrepreneurship in favor of the stability of traditional employment. Fear of sudden economic downturns, government instability, or shifting trade policies-such as increased U.S. tariffs on European goods-was a common concern. As expressed by one respondent:

"With trade barriers constantly shifting, entering global markets feels risky. My family encourages me to look for stable jobs instead of taking business risks."

4.2.2 Supportive Entrepreneurial Ecosystems

Several participants emphasized that startup incubators, mentorship programs, and digital innovation hubs provide critical support in navigating uncertainty. Access to cross-border funding, government-backed startup grants, and AI-powered market analysis tools have made it easier to identify and respond to emerging business opportunities. One participant stated:

"Having the right connections - whether through university programs, business networks, or startup accelerators - makes a big difference in feeling supported to take risks."

These findings suggest that while norms may discourage risk-taking, access to innovative business ecosystems can provide pathways to navigate uncertainty.

4.3 Perceived Behavioral Control: Strategies for Navigating Uncertainty

Participants expressed varying levels of confidence in their ability to manage geopolitical risk, and several key strategies emerged from the discussions.

4.3.1 Barriers to Control

Many participants expressed concern about their lack of influence over government policies, trade wars, and global conflicts. They emphasized how abrupt regulatory changes, such as increased U.S.-EU tariffs or sudden sanctions, can disrupt business models overnight. One of the participants stated:

"One day you're operating freely, the next day tariffs go up and your costs double. You can't plan for the long term with that kind of uncertainty."

4.3.2 Adaptation Through Digital Innovation and AI

Despite these challenges, some participants expressed confidence in the use of AI, automation, and digital platforms to increase resilience. AI-powered risk prediction tools, supply chain optimization models, and fintech solutions were seen as key drivers of adaptation. A participant noted:

"*AI helps companies predict risks, optimize logistics, and automate financial strategies. Even in a crisis, digital tools offer ways to remain competitive*."

4.3.3 Diversification and International Market Strategies

Other participants emphasized the importance of market diversification and international expansion as ways to mitigate risk. Entrepreneurs who expand into multiple regions or operate digitally are less vulnerable to regional conflicts or trade restrictions. According to a participant:

"If you create a business that's not tied to a single country or market, you're less vulnerable to sudden political or economic changes."

These responses illustrate that while geopolitical risk creates uncertainty, digital innovation and strategic planning increase perceived control over business success.

5. Discussion

The findings from the focus groups indicate that geopolitical risks present both challenges and opportunities for entrepreneurs. This is consistent with existing literature that highlights the dual nature of geopolitical risks. As Luo (2024) suggests, global instability is on the rise, and our study confirms that such uncertainties affect the business world. Some participants viewed geopolitical risks as obstacles, noting how conflicts such as the war in Ukraine and rising energy prices disrupt business planning and investor confidence.

Other participants, however, saw new opportunities in geopolitical uncertainty, particularly in sectors driven by technological innovation. In addition, the growing demand for renewable energy and AI tools mentioned by participants reflects how entrepreneurs can turn crises into opportunities, a point supported by Krasteva and Yildirim (2016), who argue that increased uncertainty can spur innovation and allow firms to take advantage of new growth opportunities.

In terms of subjective norms, the role of social and professional networks is crucial in shaping entrepreneurial behavior. Many participants mentioned the influence of family and societal expectations, which often discourage entrepreneurship due to perceived risks. However, participants also highlighted the supportive role of innovation-driven business ecosystems, such as business incubators and mentorship programs. This is consistent with the notion that well-established networks and ecosystems can mitigate uncertainty and foster entrepreneurial resilience, a point echoed by the role of digital innovation in overcoming challenges (Apostolopoulos et al., 2024).

In terms of perceived behavioral control, the findings highlight entrepreneurs' strategies for navigating uncertainty, such as adopting digital innovations and diversifying market strategies. The use of AI and automation as tools for risk forecasting and logistics optimization is consistent with the view that innovation is key to managing geopolitical risk. Moreover, the emphasis on diversification and international market strategies as a way to reduce vulnerability to geopolitical risks resonates with the sector-specific impacts of geopolitical instability identified by Kannadhasan and Das (2020). While some sectors benefit from geopolitical risks, others-

such as hospitality and travel-suffer from reduced consumer confidence, as reflected in participants' concerns about the impact on international expansion and market access.

The findings illustrate the complex relationship between geopolitical risk and entrepreneurship, with innovation and adaptability emerging as critical success factors. Entrepreneurs who can identify and act on opportunities amid uncertainty, supported by digital technologies and strong networks, are better positioned to thrive in a geopolitically uncertain world.

6. Conclusion

The purpose of this study was to examine how geopolitical risk influences entrepreneurial intentions through the lens of the Theory of Planned Behavior (TPB). The main findings suggest that geopolitical risks present both barriers and opportunities for entrepreneurship. While some entrepreneurs view global crises as significant challenges, others see them as catalysts for innovation, particularly in technology-driven sectors. The study highlighted that subjective norms, such as societal expectations and network support, play a key role in shaping entrepreneurs' responses to geopolitical risk. Perceived behavioral control was also found to be a critical factor, with entrepreneurs who use digital technologies and strategic diversification feeling more confident in managing uncertainty.

This study contributes to the existing literature by extending the TPB framework to include the influence of geopolitical risk on entrepreneurial behavior. It provides a nuanced understanding of how entrepreneurs' attitudes, perceived norms, and behavioral control interact in the context of geopolitical instability. The findings suggest that geopolitical risk may not only discourage entrepreneurship, but also drive innovation and strategic change. This work deepens our understanding of the cognitive and environmental factors that influence entrepreneurial intentions and provides valuable insights for future theoretical developments in entrepreneurship research.

From a practical perspective, the study highlights the importance of innovation and adaptability in mitigating the negative impact of geopolitical instability. Entrepreneurs can increase their resilience by adopting digital tools, such as AI and automation, to optimize operations and anticipate risks. In addition, the study highlights the importance of supportive entrepreneurial ecosystems, such as startup incubators and mentorship programs, in fostering risk-taking and helping entrepreneurs navigate uncertain environments. Policymakers and institutions should consider creating environments that encourage innovation, provide financial support, and foster cross-border collaboration to help entrepreneurs thrive despite geopolitical challenges.

This study has several limitations, including its focus on a specific demographic of business students and young entrepreneurs. Future research could expand the sample to include entrepreneurs from different industries and geographic regions to provide a more comprehensive understanding of how geopolitical risk affects entrepreneurship globally. In addition, the study's qualitative approach, while rich in insights, may limit the generalizability of its findings. Future studies could employ quantitative surveys by extending the TPB with perceived geopolitical risk as a variable.

Ethics Declaration

A written informed consent was obtained from the participants of the study. No other ethical clearance was required. The authors declare that they have no conflicts of interest.

AI Declaration

No generative artificial intelligence (AI) was used in the writing of this manuscript.

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Orchestration and Governance in the Extended Reality Ecosystem

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Abstract: This study explores through a multiple case study the dynamics related to a nascent ecosystem by examining interactions between orchestrators and complementors within an evolving technological environment. Based on multiple case studies in the extended reality technology landscape, the research identifies critical challenges related to governance, standardization, and alignment. While incumbent firms provide essential infrastructure, their pursuit of proprietary platforms and closed governance models contributes to market fragmentation and to delays in ecosystem consolidation. Complementors, facing strategic ambiguity and lacking coordination, hesitate to commit to any dominant trajectory. This study contributes to the ecosystem literature by highlighting the role of complementors in early-stage ecosystems and to XR scholarship by highlighting the governance and alignment dynamics shaping the evolving technology.

Keywords: Ecosystem, Orchestration, Digital Technologies

1. Introduction

Extended Reality (XR), a collective term for augmented reality (AR), virtual reality (VR), and mixed reality (MR), is increasingly acknowledged as a transformative suite of technologies capable of reshaping business processes, workforce training, product development, and customer engagement across diverse industries. As Porter and Heppelmann (2017) argued, XR holds the potential to unlock novel value creation opportunities, particularly within enterprise applications. Despite significant investments by incumbent technology giants such as Meta, Apple, and Google, XR adoption remains limited.

The strategic integration of XR technologies challenges traditional linear value creation models, requiring a shift toward multilateral and interdependent configurations. However, the formation of XR ecosystems is hindered by the absence of widely accepted standards, fragmented technological infrastructures, and weak alignment among key stakeholders. In such contexts, the ecosystem perspective offers a powerful conceptual lens for understanding how firms mobilize complementors, coordinate innovation efforts, and orchestrate value co-creation (Adner, 2017; Jacobides et al., 2018). While prior research has extensively examined platform-based ecosystems in mature digital markets, less is known about how ecosystems emerge in nascent, technologically immature domains like XR, particularly when led by incumbent firms (Thomas et al., 2022).

This study contributes to the literatures on business ecosystems and XR by examining, through an exploratory multiple-case study (Eisenhardt, 1989), how ecosystems emerge in early-stage, technologically immature environments. Focusing on the Italian XR context, we explore how orchestration unfolds in the absence of dominant platforms or shared governance structures. Our findings show that when the orchestrator's role is unclear, even well-resourced incumbents, who provide essential infrastructure and visibility, may hinder ecosystem development. Their pursuit of proprietary strategies and platform control creates uncertainty for complementors, making it difficult for them to align with a clear direction. This strategic ambiguity delays commitment, weakens collaboration, and slows ecosystem consolidation. We also find that roles between ecosystem actors, such as content creators and software providers, often overlap, adding further complexity. Despite growing interest in XR technologies, the lack of standardization, interoperable platforms, and coordinated leadership continues to limit adoption and ecosystem growth. By unpacking these dynamics, this study offers new insights into how ecosystems begin to form under uncertainty and fragmented leadership.

The remainder of the paper is organized as follows: Section 2 reviews the literature on XR technologies and business ecosystem. Section 3 outlines the methodological approach. Section 4 presents the empirical findings. Section 5 discusses the theoretical implications and contributions to both academic and managerial domains. Section 6 concludes the study.

2. Literature Review

2.1 XR Technologies

Extended reality (XR) constitutes a significant advancement in digital innovation, offering firms novel mechanisms to reconfigure value creation, customer engagement, and operational processes (Porter & Heppelmann, 2017; Meccawy, 2023). Comprised of augmented reality (AR), virtual reality (VR), and mixed reality (MR), XR technologies represent distinct yet complementary modalities: AR projects digital elements onto the physical environment, VR immerses users in entirely simulated spaces, and MR enables real-time interaction between digital and physical domains. These capabilities present considerable potential for strategic differentiation across a wide range of industries (Meccawy, 2023).

The rapid evolution of XR has drawn substantial investment from incumbent technology leaders such as Meta, Google, and Apple (Zabel & O'Brien, 2024; Sag, 2024). Nonetheless, widespread adoption remains constrained by persistent challenges related to usability, interoperability, and the absence of common standards. Previous work focused on mapping the virtual reality value chain (de Regt et al., 2020), however, given XR multisided architecture, encompassing hardware manufacturers, software developers, content producers, platform providers, and end users (Harbor Research, 2022), it necessitates a systemic perspective that accounts for the complex web of interdependencies among participants. As such, XR serves as a compelling empirical context for investigating the emergence of business ecosystems and the orchestration strategies employed by established firms operating within technologically nascent environments (Jocevski et al., 2020).

2.2 Business Ecosystem

Over the past two decades, the ecosystem perspective has emerged as a dominant analytical framework in management and innovation literature to capture value creation in interdependent and dynamically evolving environments. Defined as "the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize" (Adner, 2017, p. 42), ecosystems enable the generation of co-created value that no single firm could achieve independently (Lingens & Huber, 2021). This conceptual lens is particularly effective in contexts where traditional, linear models, such as value chains, fail to account for complex interfirm dependencies (Jocevski et al., 2020).

As Cobben et al. (2021) note, the field has seen the emergence of multiple typologies of ecosystems, business, innovation, entrepreneurial, and knowledge; yet lacks consensus on theoretical boundaries, governance modes, and performance goals. Among various typologies, the business ecosystem has received particular attention. In this configuration, a central firm acts as the orchestrator, coordinating a network of complementors via shared platforms, governance structures, and technological standards (Moore, 1993; Jacobides et al., 2018). Business ecosystems are not characterized by linear progression but instead evolve through iterative realignments among diverse and often competing actors (Kapoor & Agarwal, 2017), embodying both cooperative and competitive dynamics.

Despite its growing traction, fundamental questions remain unresolved regarding ecosystem emergence and governance, especially when orchestrated by incumbent firms (Krasyuk et al., 2022; Thomas et al., 2022; Lingens et al., 2021). More recent contributions have shifted attention to the evolutionary mechanisms underpinning ecosystem development, such as the articulation of a shared value proposition, role delineation, and the implementation of adaptive governance models (Nylund et al., 2022).

While prior research has largely focused on the orchestrator's role in shaping ecosystem structure and performance, increasing scholarly attention is being directed toward the understudied position of complementors. Their strategic responses, whether through alignment, resistance, or disengagement, are particularly consequential in early-stage and fragmented ecosystems, where stability and coordination remain elusive (Kapoor & Agarwal, 2017; Ritala et al., 2013). A deeper understanding of complementors' behaviors and constraints is thus essential to advancing theories of ecosystem emergence.

2.3 Literature Gap

Although scholarly interest in ecosystem formation has grown considerably, the mechanisms underlying ecosystem emergence in digitally nascent and technologically fragmented contexts remain underexplored (Thomas et al., 2022; Lingens et al., 2021). Much of the existing literature concentrates on platform ecosystems and the role of dominant orchestrators in coordinating value creation and capture (Jacobides et al., 2018). In

contrast, the strategic behavior of complementors, despite their central role in shaping ecosystem dynamics, has received comparatively limited attention (Kapoor & Agarwal, 2017; Ritala et al., 2013).

Emerging research underscores the significance of evolving actor roles, alignment mechanisms, and coordination processes, particularly in settings where orchestrator authority is ambiguous or contested (Shipilov & Gawer, 2020). However, ecosystem emergence processes led by incumbent firms, especially in early-stage digital domains, remain conceptually and empirically underdeveloped (Thomas et al., 2022; Lingens et al., 2021). Given XR's current state of technological immaturity, coupled with increasing investments from established players, it provides a timely and underutilized empirical context to investigate the question: How do the actors of an ecosystem shape its emergence?

3. Methodology

This research employs an exploratory multiple-case study approach (Eisenhardt, 1989) to examine the emergence of the extended reality ecosystem within the Italian market. The study focuses on nine case organizations, representing three primary categories of ecosystem participants: software providers (SP), content creation firms and end user firms. SPs typically develop XR solutions through software engineering, whereas content creators focus on designing 3D assets and immersive environments, they both contribute to the value architecture of the XR ecosystem. These actors represent the complementors of the business ecosystem, it was decided to analyze the relationships with the other actors. Indeed, in the literature the perspective of the complementors in rarely analyzed. Finally, end user firms relate both to companies operating in the business to business and business to consumer fields adopting extended reality solutions.

Additional actors in the XR landscape, such as original equipment manufacturers (OEMs) that produce hardware and operating systems, providers of XR engines that supply the graphical platforms for development and metaverse platform companies were not directly interviewed. However, consistent insights into their roles and constraints were derived from secondary sources and informal interactions.

The data collection process comprised nine semi-structured interviews, yielding approximately 320 minutes of audio and 195 pages of transcripts, supplemented by over twelve secondary sources, including seven consultancy firm reports and five industry reports. The analysis began with a within-case examination to establish a grounded understanding of each case, followed by cross-case analysis to identify patterns, contrasts, and thematic convergence across the dataset (Eisenhardt, 1989).

To structure the findings, we adopted the Gioia methodology (Gioia et al., 2013), organizing the data into first-order concepts based on informant-centric terms, second-order themes reflecting theoretical constructs, and overarching aggregate dimensions. This layered coding strategy ensured analytical rigor and transparency in the link between empirical evidence and emergent theory. In line with Eisenhardt's (2021) recommendations, case selection was driven by theoretical relevance rather than sample size, prioritizing those organizations capable of illuminating the phenomenon of interest. The complete coding structure is presented in Figure 1.

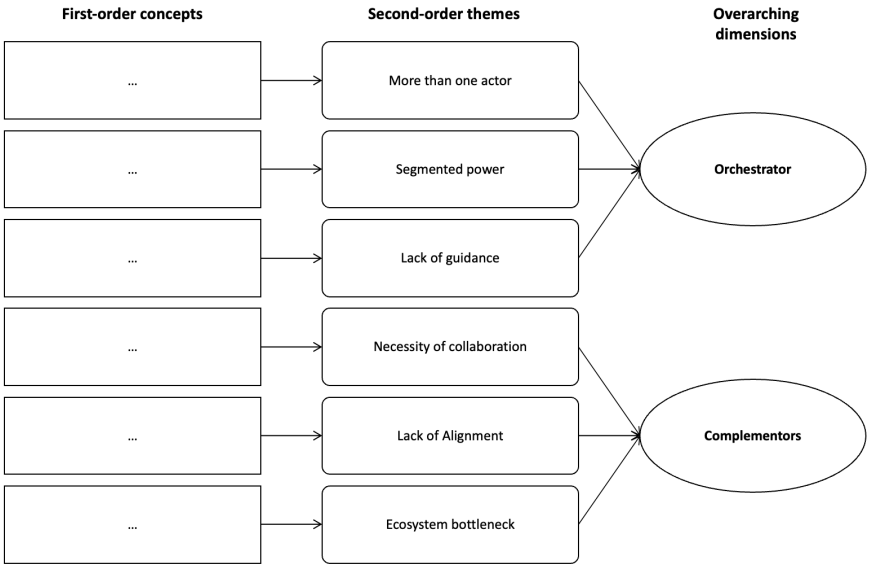


Figure 1: Coding tree structure.

4. Findings

4.1 Absence of Central Leadership

A key pattern that emerged across the cases is the absence of a clearly defined orchestrator within the XR landscape. No single actor currently demonstrates the authority or strategic positioning required to align ecosystem stakeholders, establish common standards, or coordinate investments. Instead, a few dominant incumbent firms, primarily Apple, Meta, and Google, exert influence over core technological layers, such as operating systems and hardware. However, their roles remain fragmented and partial, lacking the integrative function typically associated with ecosystem orchestrators.

These firms retain control over critical device functionalities and software interfaces, which imposes significant constraints on complementors. Respondents consistently highlighted limitations in accessing essential hardware capabilities, such as sensors and camera feeds, as a major barrier to developing complex enterprise solutions.

Some firms interpreted the strategic decisions of incumbents as indirect forms of orchestration. For example, Apple's release of a high-end, enterprise-oriented XR device was seen as a deliberate signal that the ecosystem was not yet mature enough for mainstream adoption. Similarly, Meta's early push into hardware development was perceived as an effort to stimulate community growth and platform lock-in, though its long-term orchestration capacity remains uncertain.

Overall, the absence of a centralized orchestrator contributes to strategic ambiguity and slows ecosystem formation. Complementors face difficulties in aligning their development efforts due to uncertainty over which platform will emerge as dominant. This fragmented orchestration landscape hinders standardization and delays the consolidation of a cohesive XR ecosystem.

4.2 Ecosystem Fragmentation

The Italian XR ecosystem is currently situated in an early and fragmented stage of development. This fragmentation manifests across various layers of the technological stack, including hardware devices, software platforms, and stakeholder roles. One notable empirical insight concerns the blurred boundary between content creators and software providers (SPs), whose functions often overlap in practice. Rather than operating in distinct capacities, these actors frequently engage in both software development and content production, suggesting a convergence of roles that further complicates ecosystem structure.

The interviewee also points to a lack of coherent technological and strategic direction within the ecosystem. This fragmentation appears to have been intensified by the previous wave of enthusiasm around the metaverse, which led to inflated expectations and misaligned strategic investments. The lingering effects of this hype cycle have generated skepticism and diluted the perceived legitimacy of XR as a strategic technology.

Technical incompatibilities across XR hardware and operating systems were identified as a significant barrier to alignment. Developing content for multiple devices often necessitates substantial redevelopment efforts, consuming resources and delaying deployment. Such constraints limit the scalability of solutions and deter long term investment. Many firms reported that client adoption is hindered by uncertainty regarding hardware longevity and platform stability, which undermines trust in XR as a reliable technology.

Furthermore, the tendency of firms to pursue proprietary, siloed development strategies exacerbates fragmentation. Although some actors intentionally avoid integration with third-party platforms to preserve control over margins and product direction, this isolationist stance impedes the emergence of shared standards and collaborative practices. As a result, the XR ecosystem remains disjointed, with limited interoperability and a weak foundation for collective growth.

4.3 Collaborative Dynamics

Across the examined cases, firms consistently underscored the necessity of close collaboration between technology providers and client organizations to realize the strategic potential of extended reality. Given XR's inherent complexity and nascent technological maturity, effective value creation often hinges on co-development efforts. Rather than relying on off-the-shelf solutions, providers must work in tandem with clients to tailor applications that align with specific business processes. This co-creation approach frequently entails the rethinking of existing business models to ensure mutual value realization.

Such projects are resource-intensive and depart significantly from standard software deployments. The success of XR initiatives often depends on the client's ability to dedicate internal teams capable of bridging organizational needs with technical capabilities. Participants across the study agreed that no firm can operate in isolation in this domain; instead, sustained collaboration is a prerequisite for scalable XR adoption.

Despite growing interest in XR applications, a notable disjunction persists between experimental initiatives and large-scale, institutionalized implementation. Many clients still perceive XR as a proof-of-concept technology rather than as a production-ready solution, which delays broader commitment and inhibits ecosystem maturation.

5. Discussion

The extended reality domain offers a revealing context for analyzing ecosystem emergence, as it combines conditions conducive to ecosystem formation, such as interdependence and multilateral collaboration, with many of the structural obstacles typical of nascent technological domains. Echoing established insights from the ecosystem literature (Adner, 2017; Jacobides et al., 2018), the empirical evidence underscores the strategic interdependencies between technology providers and clients, particularly in co-development efforts requiring dedicated internal resources and iterative coordination. These collaborations are further shaped by dependencies on original equipment manufacturers (OEMs), whose hardware and operating system choices critically influence project viability (Lingens & Huber, 2021).

Despite these integrative dynamics, the absence of a dominant orchestrator results in significant technological and strategic disaggregation. Without stable standards or a leading platform, complementors face uncertainty about which trajectory to follow, often deferring adoption. This fragmentation across hardware and software platforms hinders scalable innovation and creates misalignment, a condition widely recognized as essential for ecosystem emergence (Thomas et al., 2022).

The data also point to a lack of ecosystem maturity among end-user firms. Many clients possess limited awareness of XR's capabilities and approach providers seeking exploratory guidance. This blurring of roles between developers and consultants reflects a broader underdevelopment of actor specialization within the ecosystem (Nambisan & Sawhney, 2011).

Notably, unlike traditional platform-led ecosystems or those catalyzed by entrepreneurial actors (Thomas et al., 2022), XR is developing under the influence of powerful incumbent firms, each advancing distinct technological trajectories. This overlapping orchestration complicates alignment, inhibits standardization, and slows ecosystem consolidation.

Considering the findings, the emergence of the XR ecosystem appears contingent upon resolving the **strategic ambiguity** experienced by complementors, who currently lack sufficient signals to commit to specific platforms or ecosystem trajectories (Kapoor & Agarwal, 2017). This ambiguity, exacerbated by overlapping and uncoordinated orchestration attempts from powerful incumbents leads to inertia and inhibits structural alignment (Thomas et al., 2022). To transition from fragmentation to formation, findings show that the XR ecosystem should be supported by **shared orchestration frameworks** that go beyond technological control and incorporate inclusive governance, open standards, and mechanisms for multilateral coordination (Adner, 2017; Jacobides et al., 2018). These dynamics further highlight insights from the digital business ecosystem literature (Hanelt et al., 2021; Senyo et al., 2019), which emphasize that ecosystem emergence in digitally mediated contexts is shaped by technological uncertainty, strategic ambiguity, and fluid inter-organizational roles. However, our findings extend this stream by highlighting how the lack of a clear orchestrator despite the presence of resource rich incumbents can amplify these challenges, especially for complementors navigating early-stage digital convergence.

5.1 Theoretical Contributions

This study makes two primary contributions to the literature on ecosystem emergence and extended reality. First, it extends existing research on orchestration and ecosystem formation (Lingens & Huber, 2021; Thomas et al., 2022) by underlining that ecosystems led by powerful incumbent firms encounter a distinctive form of early-stage complexity. While these actors provide essential infrastructure and market legitimacy, their concurrent pursuit of proprietary strategies and platform leadership introduces strategic ambiguity for complementors. In the absence of standardized governance and clear focal leadership, complementors hesitate to align with a single trajectory, resulting in persistent structural dispersion and hindering ecosystem consolidation. This finding

adds nuance to prevailing models of orchestrated emergence by illustrating how multiple dominant orchestrators, operating without coordination, can obstruct alignment particularly in institutionally fluid and technologically immature domains such as XR.

Second, this study extends research on digital business ecosystems by highlighting how the absence of a clear orchestrator, despite the presence of resource-rich incumbent firms can exacerbate challenges typically associated with early-stage ecosystem emergence. While prior literature has emphasized the role of technological uncertainty, strategic ambiguity, and fluid inter-organizational roles in shaping digitally mediated ecosystems (Hanelt et al., 2021; Senyo et al., 2019), our findings show that overlapping and uncoordinated orchestration attempts by incumbents further amplify these issues. This insight deepens understanding of how misalignment and inertia can persist even in ecosystems supported by powerful actors, particularly when complementors lack guidance during early digital convergence.

5.2 Practical Contributions

This research yields several actionable insights for practitioners and policymakers engaged in the development of XR ecosystem. First, original equipment manufacturers (OEMs) should recognize that technological dominance alone does not equate to effective ecosystem leadership. To foster adoption and generate sustained value, these actors must also cultivate inclusive governance frameworks, promote interoperability through open interfaces, and establish collaborative platforms that facilitate complementor participation.

Second, end-user organizations should move beyond expectations of stand alone XR solutions. Instead, successful implementation requires active engagement with technology providers, including the allocation of internal resources such as cross-functional teams and integration of 3D workflows. Such co-development practices are essential to tailoring XR applications to firm-specific operational contexts.

Third, public institutions and industry consortia have a critical role to play in supporting the ecosystem's structural maturation. Initiatives such as standard-setting bodies, public-private partnerships, and innovation testbeds can help mitigate fragmentation, de-risk experimentation, and accelerate the transition from pilot projects to scalable deployments.

5.3 Limitations and Future Research Avenues

Given the limited body of research on XR ecosystem emergence, this study employed an exploratory multiple case study approach to generate rich, context-specific insights. While this methodology offers depth, it is inherently susceptible to interpretive bias from both researchers and participants, which may affect the generalizability of findings (Yin, 2014). Future research could build on these insights by adopting quantitative or longitudinal designs to systematically examine how alignment, orchestration, and performance evolve over time.

Furthermore, the study's focus on the Italian XR market, characterized by its unique institutional and infrastructural conditions, limits the applicability of findings to broader contexts. Cross-national comparative research or studies on adjacent digital technologies (e.g., Blockchain, IoT) would help validate and extend the theoretical contributions, advancing a more comprehensive understanding of ecosystem emergence under conditions of technological uncertainty.

6. Conclusions

This study examined the emergence of the XR ecosystem within a technologically immature and structurally fragmented environment, emphasizing the strategic roles of incumbent firms and complementors. While technological progress, particularly in hardware and immersive content, has sparked enterprise interest (Porter & Heppelmann, 2017; Meccawy, 2023), the ecosystem remains in a formative state. The findings reveal that the absence of clear governance structures, interoperable standards, and a defined orchestrator hinders coordination and delays broader adoption. Complementors, lacking guidance and facing high uncertainty about which technological trajectory to support, are reluctant to commit, further stalling ecosystem consolidation (Kapoor & Agarwal, 2017).

Importantly, the study highlights how ecosystems led by powerful incumbents may face unique barriers in their early stages. Rather than fostering alignment, overlapping and uncoordinated orchestration efforts can exacerbate strategic ambiguity and fragmentation (Thomas et al., 2022; Lingens & Huber, 2021). This insight

extends existing research on digital business ecosystems by showing that incumbent participation alone is insufficient to ensure effective ecosystem formation. Even in contexts where technologically and financially strong firms are involved, the lack of clear orchestration can lead to inertia and misalignment (Hanelt et al., 2021; Senyo et al., 2019).

To overcome these challenges, the XR ecosystem requires collaborative orchestration mechanisms that promote open standards, inclusive governance, and multilateral coordination (Adner, 2017; Jacobides et al., 2018). Such structures are essential not only to guide complementors but also to reduce risk and support the transition from experimentation to institutionalized deployment (Moore, 1993; Nambisan & Sawhney, 2011).

Overall, this study contributes to ecosystem theory by shedding light on the complex interplay between orchestration, alignment, and actor interdependence in nascent technological domains. It also offers actionable implications for managers, policymakers, and developers seeking to navigate and shape emerging digital ecosystems under uncertainty.

Ethics Declaration

This research is based on qualitative data collected through semi-structured interviews with professionals working in the extended reality industry. All participants were informed about the purpose of the study, and their participation was entirely voluntary. Data were anonymized to ensure the privacy and confidentiality of respondents.

According to the institutional guidelines and national regulations applicable at the time of data collection, formal ethical clearance was not required for this type of research. Nonetheless, the study was conducted in accordance with the ethical principles and followed best practices for responsible research involving human participants.

AI Declaration

Artificial Intelligence tools were employed during the preparation of this manuscript to enhance the overall writing quality. Specifically, AI was used to improve linguistic clarity, rephrase content for better readability, and correct grammatical and stylistic errors. The intellectual content, analysis, and conclusions remain entirely the product of the authors' original work, and AI was not used to generate substantive ideas or interpret empirical findings.

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Digital Literacy as a Catalyst for M-Commerce Adoption in South Africa

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Abstract: The global digital economy has undergone significant transformations especially with the rise of mobile commerce in emerging markets like South Africa. Digital transactions have become more accessible through the increasing adoption of smartphones and numerous mobile payment solutions. However, this transition has come with challenges, especially in developing economies like South Africa. Therefore, digital literacy remains a crucial factor in consumer participation in the digital economy. The digital divide in South Africa in addition to cyber security concerns and limited digital skills hamper consumers from engaging with online platforms confidently. These challenges need to be addressed to achieve inclusive economic growth. This study explores the impact of digital literacy on mobile commerce adoption in South Africa and introduces a Digital Literacy Checklist for mobile commerce as a practical tool to assess and enhance consumer readiness. Embedded in Digital Inclusion Theory and Consumer Empowerment Theory, this study employs a qualitative approach by integrating interviews and a content analysis to analyze how consumers interact with digital platforms. Interviews were conducted with electronic commerce professionals to understand the digital literacy challenges and opportunities. In addition, policy documents, digital literacy training material and reports were reviewed to assess the current frameworks and strategies as well as identify gaps in consumer preparedness. Findings suggest that digital literacy enhances consumer confidence in online transactions, the ability to identify fraudulent scams and the awareness of mobile payment security features. The key barriers to mobile commerce adoption were limited digital skills, trust and security concerns and socio-economic disparities. Findings also suggest that higher levels of digital literacy correlate with increased confidence in online shopping, mobile payments and financial transactions. This in turn leads to a more inclusive and competitive digital economy. This study contributes to the discourse on digital transformation by highlighting strategies to improve digital literacy. In turn, business innovation, economic inclusion and sustainable growth in mobile commerce's eco-systems are driven. Businesses, policy makers and educators can make use of these insights to create targeted interventions that are able to empower consumers to enhance resilience in the digital economy.

Keywords: Global Digital Economy; Mobile Commerce; Digital Literacy; Economic Inclusion; Digital Literacy Checklist.

1. Introduction

There has been a remarkable surge in mobile commerce (m-commerce) within South Africa which is being driven by the widespread adoption of smartphones as well as the proliferation of mobile payment solutions (CHANNELmobile,2025: 1). According to Statista (2025), smartphone penetration has amounted to US$ 3.1 bn which in turn has created a fertile ground for digital transactions. Mobile payment platforms such as PayPal, Zapper, SnapScan as well as mobile banking applications (apps) have become an integral part of consumers' daily financial activities. This transition has democratized access to electronic commerce (e-commerce) and consumers in both urban and rural areas are able to participate in the digital economy.

Despite this significant growth of m-commerce, South Africa faces significant challenges brought about by the digital divide. The digital divide is characterized by disparities in digital skills, access to affordable Internet and technological infrastructure (International Trade Administration, 2024: 1). Many individuals, especially in the underserved and rural communities, do not have the necessary knowledge and resources to fully engage in the digital economy. In addition to this, cybersecurity threats such as data breaches, phishing scams and identity theft bring about substantial risks for consumers. Such threats hinder m-commerce adoption because it creates issues around trust in online transactions. The Banking Association South Africa (2025) reports that there has been a surge in phishing scams particularly targeting mobile banking users which has led to significant financial losses in South Africa.

This research study investigated the impact of digital literacy on m-commerce adoption in South Africa and focused on the challenges as well as opportunities for consumers. By creating a Digital Literacy Checklist for commerce, this research study seeks to provide a practical tool that can be used to assess as well as enhance consumer readiness. This research study contributes to the existing literature by providing insights into the specific challenges faced by South African consumers as well as proposes actionable strategies for the promotions of digital inclusion and economic empowerment. This research study sought to explore how digital literacy influences m-commerce adoption in South Africa, especially among underserved communities that are faced with barriers to digital inclusion. Digital Inclusion Theory and Consumer Empowerment Theory guided this research study.

1.1 Research Questions and Hypothesis

The following research questions drove this study:

- How does digital literacy affect the confidence of consumers in using m-commerce platforms in South Africa?
- What role does cybersecurity awareness play in improving trust in mobile payment systems?
- What are the main digital literacy barriers to m-commerce adoption in underserved communities?
- How can a customized digital literacy checklist be used to assess and enhance consumer readiness for m-commerce?

The following hypothesis guides this research study and is based on the themes identified in the research objectives and literature: Higher levels of digital literacy influence the adoption of m-commerce among South African consumers positively.

2. Digital Inclusion Theory and Consumer Empowerment Theory

Digital Inclusion Theory affirms that equitable access to and effectively using digital technologies are crucial for social and economic participation (Heeks, 2022: 689). In the context of m-commerce, Digital Inclusion Theory puts emphasis on bridging the digital divide to allow all segments of society to benefit from digital transactions (Sharp, 2022: 4). This includes providing access to digital literacy training, digital devices and affordable Internet. Consumer empowerment Theory places emphasis on how digital literacy can empower individuals in making informed decisions as well as engaging confidently in the digital marketplace (Tana, Chai & Li, 2024: 2). Consumers will be able to effectively navigate online platforms in a safe manner, safeguard their personal information and make informed purchasing decisions by acquiring the necessary digital skills. Studies by Adel (2024), Mendez-Dominguez, Carbonero, Raya & Castillo De Mesa (2023) and Moleko (2022), emphasize the crucial role of digital literacy in fostering digital inclusion as well as economic development in emerging markets. These studies call for context-specific interventions that will address the unique challenges faced in different communities. In South Africa, m-commerce adoption is hindered by many factors such as the lack of digital literacy skills, limited access to affordable Internet and high data costs. Ebrahim & van den Berg (2024) demonstrates how these barriers disproportionately affect marginalized communities which in turn exacerbate existing socio-economic disparities. Cybersecurity threats are a significant barrier to m-commerce adoption especially in emerging markets like South Africa. Cele and Kwenda (2024) and Investec (2025) report that there is an increase in cybercrimes that targets online banking and mobile payment users. These kinds of threats deter individuals from trusting online transactions which leads to individuals not wanting to engage in online transactions.

3. Research Methodology

This research study adopted a qualitative research approach that was guided by the research onion to gain in-depth insights into the impact of digital literacy on m-commerce adoption in emerging markets like South Africa (Saunders, Lewis, Thornhill, & Bristow, 2019: 130). This research study adopts a qualitative design because it focuses on understanding the context-specific challenges and subjective experiences that are related to digital literacy and m-commerce in South Africa. A qualitative approach was appropriate because of the exploratory nature of the research questions which focus on the behaviors, perceptions and meaning of individuals. Using semi-structured interviews as well as a content analysis, this research study was able to interpret how digital literacy affects the confidence, trust and readiness of consumers in engaging with m-commerce platforms. Using thematic analysis and inductive reasoning supports the qualitative orientations of this research even more. This allowed for the emergence of themes and patterns which were also grounded in real world digital inclusion strategies and lived experiences. The research onion discusses the systematic approach to research design which consists of the research philosophy, research approach, research strategy, research choices and research techniques.

3.1 Research Philosophy: Interpretivism

The research study adopted an interpretivist research philosophy which claims that reality is socially constructed while knowledge is subjective (Saunders *et al*, 2019: 141). The interpretivist philosophy aligns with the study's research aims to understand the perspectives and lived experiences of consumers and e-commerce professionals with regards to digital literacy and m-commerce adoption. Interpretivism places emphasis on the

significance of exploring how individuals understand their experiences. Thus, it is an appropriate philosophy to investigate digital inclusion. The need to understand the participants, experiences, perceptions and contextual factors as well as the exploratory n

3.2 Research Approach: Inductive Reasoning

Between the inductive and deductive research approaches, the inductive research approach was best suited because this approach involved collecting data and then developing themes and patterns form the data collected as opposed to testing a pre-existing hypothesis (Saunders *et al*, 2019: 146). This research approach allowed for new insights and perspectives to emerge as well as led to the creation of the digital literacy checklist which was created directly from the data that was collected.

3.3 Research Strategy: Qualitative Multi-Method Design

A qualitative multi-method research strategy was employed as semi-structured interviews as well as a content analysis was carried out. This research study adopted a qualitative research design to explore the impact of digital literacy on m-commerce adoption in South Africa.

3.4 Semi-structured Interviews

Semi-structured interviews were conducted with 15 e-commerce professionals representing the digital ecosystem in South Africa. Marketing managers specializing in digital marketing in the online retail industry, mobile application developers in the m-commerce industry, cybersecurity specialists with expertise in the mobile payment industry and customer support managers of e-commerce platforms were included. The interviews were conducted in person over a six-week period during October and November 2024 in Johannesburg and Cape Town South Africa. The mentioned urban centers were chosen as they are the digital and commercial hubs within South Africa. The participants were primarily based in urban and peri-urban areas, however many of them worked for national platforms that cater to rural users. This allowed the broader consumer landscape to be included. Each interview was about 45 minutes long. This time frame allowed for the sufficient flexibility of scheduling the interviews thus reaching thematic saturation.

A diverse range of expertise and perspectives were needed thus purposive sampling was used (Islam & Aldaihani, 2022: 6). Each participant was selected because of their knowledge regarding digital literacy challenges in South African and because of their experiences in the m-commerce sector. The sample size of 15 achieved thematic saturation because the data reached a point of redundancy as new interviews were not providing new findings or themes. The key themes surrounding the interview questions were the role of digital literacy in fostering consumer trust, the impact of cybersecurity concerns on consumer engagement, the challenges and opportunities for promoting digital literacy among m-commerce users and the effectiveness of current digital literacy training initiatives. The interview questions were open ended and prompts were also used to encourage participants to provide in-depth responses. All interviews were conducted face to face and lasted approximately 45 minutes. In addition, all interviews were audio-recorded with the participants' consent. Thematic analysis was used to analyze the interview transcripts. A systematic process of identifying, analyzing and reporting themes within the data was employed.

3.4.1 Document and Content Analysis

A content analysis was conducted using 20 digital literacy training materials, policies and reports from various organizations. The following five international frameworks and guidelines were analyzed: UNESCO Digital Literacy Framework, European Digital Competence Framework (DigComp), ISTE Standards for Students, OECD Digital Skills Framework, and ITU Digital Skills Toolkit. The following five regional and African resources were analyzed: Research ICT Africa Report, Smart Africa Digital Skills Initiatives, African Declaration on Internet Rights and Freedoms, Alliance for Affordable Internet Reports and SADC Digital Skills Strategy were analyzed. The following South African resources were analyzed: Department of Communications and Digital Technologies Digital Skills Strategy, South African Communications Regulatory Authority Reports, SABRIC, CERT-ZA Cybersecurity guidelines, Code4Change, reports from Vodacom, Telkom, MTN and Cell C as well as resources from the Financial Sector Conduct Authority were analyzed. The documents were selected because they were relevant to the study's research questions as well as because of its potential to provide a snapshot of South Africa's digital literacy initiatives. The analysis focused on providing the definitions and frameworks used to address digital literacy, the interventions and strategies that were implemented to promote digital literacy, the

gaps and limitations of current digital literacy initiatives and whether there was information about online security and fraud preventions within the documents. A detailed coding framework was created with broad categories such as definitions, training strategies, policy recommendations and security awareness. Under each of the broad categories with sub-categories under 'definitions' such as basic digital skills, critical evaluation of information and online safety. The coding framework was applied to each of the 20 documents and ATLAS to software was used to code the data.

3.5 Ethical Considerations

All applicable ethical considerations were addressed by obtaining informed consent from each of the participants before conducting the interviews. Participants were informed about the purpose of this research study, how and what data would be collected and used as well as their right to withdraw from this study at any time. The audio recordings as well as transcripts were anonymized to protect the participants' confidentiality. This research study adhered to all the ethical guidelines of The University of Johannesburg's Ethics Committee. The data collected for the content analysis was publicly available, thus a secondary data collection form was filled out for approval and referenced appropriately in the research study.

4. Findings and Results

The analysis of the semi-structured interviews as well as the content analysis of the 20 documents yielded key themes relating to digital literacy and m-commerce adoption in South Africa. The findings are visually presented in figure 1 below and then discussed in detail as well.

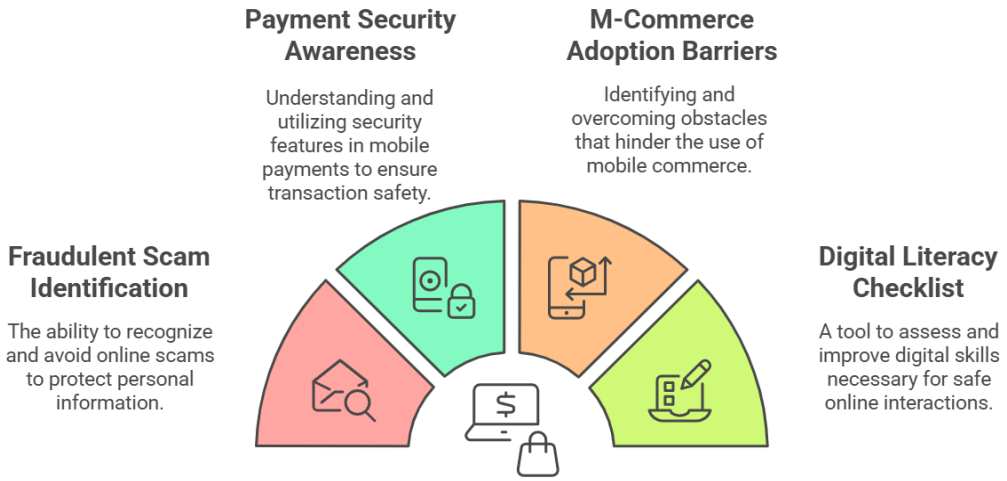


Figure 1: Enhancing Consumer Confidence Through Digital Literacy in M-Commerce (Source: Author's Own).

4.1 Building Consumer Confidence Through Digital Literacy

The participants consistently emphasized a strong correlation between digital literacy and consumer confidence in m-commerce. A cybersecurity specialist reported that when consumers understand how online transactions work, their fear is reduced significantly as the consumer is aware of which websites are secure as well and can recognize potential scams. One of the marketing managers also reported that consumers who are digitally literate trust online payment systems more because they are aware of the security measures that are in place. In addition to this, the ITU Digital Skills Toolkit, OECD Digital Skills Framework and SABRIC Cybersecurity Awareness materials highlight the importance of educating consumers about transacting securely which directly contributes to increased confidence. Thus, a direct correlation between understanding security measures and consumer confidence kept recurring as a theme across the interviews and content analysis. This finding represents the checklist item for checking whether the padlock symbol is visible in the address bar of the website that the consumer plans to purchase from because the padlock symbol indicates that the website is secure.

4.2 Recognizing and Avoiding Online Scams

Higher digital literacy skills improve the consumers ability to recognize as well as avoid online scams. This was another theme that was continuously highlighted by the participants. A developer stated that a lot of fraudulent

apps mimic legitimate apps but when consumers are digitally literate, they will be able to recognize this. Adding to this, one of the cybersecurity specialists said that when consumers understand what phishing is and how it works, they are less likely to fall victim to it because they can spot suspicious sender addresses, suspicious requests for information and grammatical errors. ITU Digital Skills Toolkit, OECD Digital Skills Framework and African Declaration on Internet Rights and Freedoms documents all supported the above statements and led to checklist item of 'can you recognize phishing email or SMS'?

4.3 Awareness of Mobile Payment Security Features

The training materials from major South African mobile payment organizations strongly emphasize educating consumers on the security features such as two-factor authentication (2FA) and transaction verification. FNB explains how to set up 2FA and how it adds an extra layer of protection. In addition, a customer support manager explained that when consumers understand 2FA, they are more likely to set it up and this in turn will reduce unauthorized access to their accounts. A marketing manager said that campaigns promoting 2FA among other security features are regularly being implemented. This focus on security features directly influenced the checklist item relating to 2FA.

4.4 Barriers to M-commerce Adoption

The three prominent themes that came up as barriers to m-commerce adoption were the lack of basic digital literacy skills, trust and security concerns and socio-economic disparities. With regards to limited digital skills, majority of the participants emphasized the need for consumers to at least have basic digital literacy skills. One of the application developers stated that many users struggle to use the basic smartphone functions such as navigating the settings or downloading apps and this contributes to the difficulty of using m-commerce applications. The customer support managers all said that they receive many calls from users that do not know how to use their mobile banking apps and payment systems which triggered two more checklist items. Concerns about data privacy and online fraud are significant deterrents to commerce adoption. Participants reported that many consumers are hesitant to shop online because they fear their personal information will be stolen and they will be scammed. One of the cybersecurity specialists affirmed that the high rate of cybercrime in South Africa erodes consumer trust in online platforms. Lastly, socioeconomic disparities such as limited access to affordable Internet and digital devices significantly hinders m-commerce adoption. Almost all the participants reported that the underserved communities and rural areas lack the resources and infrastructure that is necessary to participate in the digital economy. A marketing manager claimed that the high cost of data and lack of Internet access are major barriers for South Africans especially in the rural areas. Research ICT Africa, Alliance for Affordable Internet Access and SADC Digital Skills Strategy all support this finding as well.

4.5 Development of the Digital Literacy Checklist

The Digital Literacy Checklist in Table 1 below was created by understanding the core components that make up digital literacy such as basic computer and smartphone skills, information literacy, online safety and security, communication and collaboration skills and digital citizenship. The research study's focus is on m-commerce, thus only skills directly relevant to mobile transactions were included such as mobile banking, mobile payment apps and online shopping. Cybersecurity principles were incorporated as they address the risks linked to online transactions such as online scams and phishing. The Digital Literacy Checklist was adapted to the South African context referring to mobile payment platforms because it is commonly used by South Africans. In addition to this, the issue of high data costs as well as the high rate of cybercrime in the country were also factors. Lastly, the principles of digital literacy, m-commerce best practices, contextual knowledge and cybersecurity awareness from both the content analysis and interviews were synthesized. Based on the findings, a Digital Literacy Checklist was developed which serves as a practical tool to assess and enhance consumer-readiness for e-commerce.

Table 1: Digital Literacy Checklist (Source: Author's Own)

Digital Literacy Checklist This checklist is designed to help you assess your digital skills for safe and effective mobile commerce. Answer each question honestly. If you answer "**No**" to several questions, consider seeking training or assistance to improve your digital literacy skills. **Yes=1 and No=0**		
Scoring: • **14-21 Yes:** You have strong digital literacy skills. • **7-14 Yes:** You have moderate digital literacy skills. You will benefit from further training. • **Below 7 Yes:** You need significant assistance with your digital literacy skills.		
Section 1: Basic Digital Skills	**Yes (1)**	**No (0)**
1.1 Can you confidently navigate the settings on your smartphone? (adjust volume, screen brightness, Wi-Fi settings)		
1.2 Can you download and install apps from official app stores (Google Play Store, Apple App Store)?		
1.3 Can you use a mobile web browser to search for information online?		
1.4 Do you know how to connect to a secure Wi-Fi network?		
1.5 Can you send and receive emails and SMS messages?		
Section 2: Mobile Payment and Online Transactions		
2.1 Do you understand how to use mobile banking apps (FNB, Standard Bank, Absa)?		
2.2 Have you turned on two-factor authentication for your mobile banking app? (This adds an extra layer of security.)		
2.3 Do you know how to check your transaction history on your mobile banking app?		
2.4 Can you use mobile payment platforms like Payfast or PayPal to make payments?		
2.5 Before you buy something online, have you checked if the website has a padlock symbol (🔒) in the address bar? (This shows the website is secure.)		
2.6 Do you know how to safely store your passwords and PINs?		
Section 3: Online Safety and Security		
3.1 Can you recognize a phishing email or SMS? (does it ask for your password or personal information?)		
3.2 Do you know not to share your personal information (ID number, bank details) with unknown individuals online?		
3.3 Do you avoid clicking on suspicious links or attachments in emails or SMS messages?		
3.4 Do you know how to report a fraudulent transaction to your bank or mobile payment provider?		
3.5 Do you regularly update the security software on your smartphone?		
3.6 Do you understand the importance of creating strong, unique passwords?		
Section 4: Data Management and Awareness		
4.1 Do you understand how mobile data usage works and how to monitor your data consumption?		
4.2 Are you aware of the risks of using public Wi-Fi for sensitive transactions?		
4.3 Do you know how to clear your browsing history and cache on your mobile browser?		
4.4 Do you know where to find reliable information about online safety and m-commerce? (Government websites, NGO websites)		

5. Discussion and Implications

The significant role of digital literacy in m-commerce adoption within the unique landscape of South Africa is understood in the findings of this research study. The consistent emphasis of digital literacy as a driver for consumer confidence exhibits its pivotal role in navigating the complexities of online transactions. The discussion is visually presented in the figure below and then discussed.

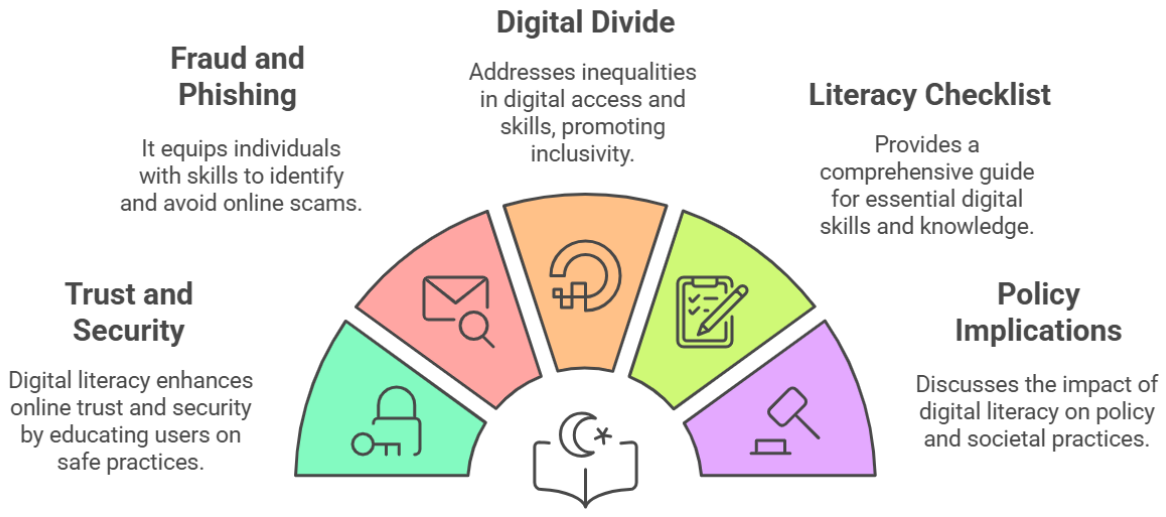


Figure 2: Empowering Trust and Security Through Digital Literacy Skills (Source: Authors Own).

5.1 Trust and Security through Digital Literacy

This research revealed a strong correlation between digital literacy and consumer trust in m-commerce platforms. Participants highlighted that when users understand security protocols such 2FA and https protocols, fears of online transactions are mitigated. Within the context of-m-commerce, digital literacy improves perceived usefulness and perceived ease of use. The Digital Literacy Checklist, which is directly informed by these findings, serves as an assessment tool for empowering consumers by assessing their understanding of

such security measures. Within the context of m-commerce, digital literacy enables individuals to use online platforms effectively as well as educate them about the security features. The Digital Literacy Checklist, which is directly informed by the findings of the study, serves as a practical assessment tool that can empower users because it assesses and improves their understanding of security measures.

5.2 Digital Literacy and Cyber Fraud Prevention

Being able to recognize and avoid fraudulent scams such as phishing attacks emerged as a critical outcome of digital literacy. The documents and participants highlight the significance of educating consumers about common phishing techniques and suspicious online activities. The finding addresses the importance of integrating cybersecurity awareness into digital literacy training programs. The checklist item regarding phishing serves as a proactive measure to enhance consumer vigilance.

5.3 Addressing the Digital Divide in South Africa

The digital divide in South Africa is an issue that is complex, and a multi-faceted approach is needed. The approach should encompass several things. Firstly, affordable and reliable Internet access must be provided particularly for the underserved and rural areas. Partnerships with mobile network operators to offer affordable data packages, infrastructure development and community Wi-Fi projects could possibly be great solutions to these issues. The digital needs and digital skills of South African consumers vary, thus targeted digital literacy training programs need to be implemented. Such programs should focus on basic digital literacy skills, using m-commerce platforms and online safety. Online tutorials, community-based training and mobile training units could be very effective strategies. Digital Inclusion initiatives that address socio-economic disparities need to be promoted. Providing access to affordable digital devices, offering financial literacy training as well as supporting small businesses in adopting m-commerce business practices will help realize such initiatives. The digital divide can be addressed by leveraging the expertise and resources of government, NGOs, the private sector and community organizations. The Digital Literacy Checklist is designed to serve as a self-assessment tool for consumers. The checklist provides a structured way for consumers to evaluate their digital literacy skills and then also identify areas for improvement. Consumers will be able to use the checklist to assess their readiness for m-commerce, identify the skills that they need to develop, track their progress regarding their digital literacy skills development and use the checklist as a prompt for conversations with others that are more digitally literate.

5.4 Implementing the Digital Literacy Checklist

The Digital Literacy Checklist in Table 1 should be distributed in a variety of mediums such as printed copies in community libraries and centers as well as digital copies on NGO and government websites. If the digital copy is being used, then the participant should either write ‘1’ if their answer is yes and ‘0’ if their answer is no. The number of yes and no answers will be automatically calculated for ease of counting, which will be beneficial for larger audiences. If the Digital Literacy Checklist is printed in hard copies, then the number of yes and no answers will need to be counted manually. The checklist was informed by the data collected from the interviews and the content analysis. The widespread adoption of this checklist could lead to increased digital literacy among consumers resulting in more confident individuals participating in m-commerce. The objective of economic empowerment can be met, especially for marginalized communities. The checklist can also aid in reducing online fraud as well protect consumers from financial losses by promoting cyber-security risks. The Digital Literacy Checklist can be used as a pre and post assessment tool by implementing it into existing digital literacy training programs. Trainers can use this checklist to identify the specific needs of individuals and then tailor their training accordingly. In addition to this, new training materials and modules can be developed by using the checklist as a guide.

5.5 Policy and Educational Implications

The findings revealed implications for policy and practice. Digital literacy needs to be integrated into school curricula on all levels from primary to tertiary. Some ways can be teaching basic computer skills, how to critically evaluate online information as well as online safety. Educational institutions can further provide training relating to using m-commerce platforms and mobile payment solutions. Government policies should promote digital inclusion through investing in its infrastructure development for Internet access, provide funding for digital literacy programs, enact consumer protection laws that address data privacy and online fraud, support initiatives

specifically focusing on the promotion of digital entrepreneurship as well as address the high costs of mobile data and implement strategies to lower the cost of data.

5.6 Study Limitations and Future Research

It is important to note that this Digital Literacy Checklist is not a substitute for digital training but rather a guide as it will provide a snapshot in an individual's digital literacy skills. The digital landscape is constantly evolving and allows for the emergence of new technologies and threats. Thus, the checklist will need to be updated to reflect such changes to ensure its relevance. This research study has some limitations that should be acknowledged. The study's qualitative design is rich in insight but can be seen as generalizing broader consumer populations. The findings reflect institutional viewpoints as opposed to consumer viewpoints. Lastly, the findings are rooted within the South African context thus may limit its applicability to other national settings. These limitations point to opportunities for future research. Future studies can incorporate the consumer's voice especially from underserved communities. Quantitative validation of the checklist can be done, which could then transform it into a standardized assessment tool. Lastly, exploring digital literacy and m-commerce adoption in other African contexts can assist with the transferability of the checklist.

6. Conclusion and Recommendations

This research study explored the link between digital literacy and m-commerce adoption in South Africa. Through integrating rich interview data and systematic content analysis, the impact of digital literacy on consumer confidence, security awareness and digital inclusion was discovered. The findings prove that digital literacy is a foundational pillar and not just a supplementary skill for m-commerce adoption. Participants continuously highlighted the importance of empowering users to navigate online transactions. From the insights gathered, the Digital Literacy Checklist was created as a practical application of this research study providing a tangible way for individuals to assess and enhance their digital literacy skills. This research also offers actionable insights geared towards businesses, educators and policymakers. Targeted digital literacy initiatives addressing the specific needs of South African consumers especially those in underserved communities must be a priority. Advocating for expanded Internet access, affordable data and context-specific training programs, the barriers that hamper digital inclusion in South Africa can be overcome.

Ethics Declaration

Ethical Clearance has been obtained for this Research Study and has been reviewed by the School of Consumer Intelligence and Information Systems at The University of Johannesburg.

AI Declaration

No AI tools were used in the creation of this paper.

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Evaluating the Effectiveness of a Rule-Based WhatsApp Chatbot in Automated Query Resolution

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Abstract: Conversational chatbots have become integral to automated query resolution across industries to enhance customer service efficiency. However, their effectiveness in accurately addressing diverse customer queries remains a critical area of evaluation. This study examines the performance of a rule-based WhatsApp chatbot deployed by a South African telecommunications service provider, focusing on its ability to resolve customer queries effectively. This paper analysed chatbot interaction reports and quantifies success, failure, and abandonment rates across various query types. This study adopted a quantitative research approach with interpretivism as a philosophical paradigm. Furthermore, document analysis was employed for the analysis of TELCO X WhatsApp Chat's extracted reports to examine and evaluate human-chatbot interaction. This method allowed the researcher to determine, from the interactions, resolved and unresolved queries. The findings indicate that the chatbot achieves high success rates for routine and structured queries, such as Frequently Asked Questions (FAQs) and retrieving account-related information. However, the chatbot's performance declines significantly in handling complex, multi-step, or context-dependent queries, including SIM swaps and product purchases. The chatbot exhibits lower success rates, with a significant number of customer interactions resulting in unresolved queries or user abandonment. The analysis highlights key performance limitations, including natural language understanding, contextual retention, and the inability to process multi-step interactions effectively. Additionally, the absence of seamless escalation mechanisms to human agents contributes to customer frustration when the chatbot fails to provide satisfactory resolutions. The study provides recommendations for optimising chatbot performance, particularly in enhancing AI-driven response mechanisms, refining intent recognition, and using advanced dialogue management techniques. Additionally, integrating seamless escalation pathways to human agents is proposed to improve resolution rates for complex queries. In conclusion, the study emphasizes the importance of continuous performance monitoring and iterative improvements. Identifying key performance gaps and improvement areas provides valuable guidance for organisations looking to optimise chatbot functionality.

Keywords: Chatbots, Query Resolution, Artificial Intelligence (AI), Whatsapp, Customer Queries.

1. Introduction

Artificial Intelligence (AI) is a transformative technology that has profoundly impacted numerous industries, such as healthcare and financial services, since the advent of the Fourth Industrial Revolution (4IR) (Nyongesa, Omieno, & Otanga, 2020:106). Organisations continually embrace change to leverage technologies that enhance business operations and customer service. One prominent outcome of this technological evolution is the rise of chatbots, which serve as live communication interfaces enabling real-time customer support and direct interaction between organisations and their customers across various frontline services (Pillai & Sivathanu, 2020:3199). Chatbots have found applications in diverse sectors, including financial services and insurance, where they play a crucial role in addressing customer queries. Realising the full potential of chatbots necessitates that organisations develop chatbot systems that align with industry standards and customer service expectations, and chatbot effectiveness in resolving customer queries remains a critical area of evaluation due to limitations in contextual comprehension and constrained natural language processing (Adam, Wessel, & Benlian, 2020:427; Følstad & Taylor, 2021:1). Organisations therefore need to enhance their capabilities for assessing and monitoring customer interactions with chatbots. This study examines the performance of a rule-based WhatsApp chatbot deployed by a South African telecommunications service provider (alias "TELCO X") to assess its ability to address diverse customer queries accurately. The analysis uses chatbot use case reports collected over four months (December 2022 to March 2023) to quantify key performance metrics, including success, failure, and abandonment rates, across various query types to provide insights into the chatbot's strengths and limitations in automated customer service.

The main objective of this research study was to evaluate the effectiveness of a rule-based WhatsApp chatbot that handles customer queries for a South African telecommunications provider. The research proposed the following research questions:

- What is the success rate of a rule-based WhatsApp chatbot in resolving different categories of customer queries?
- How do failure and abandonment rates vary across the different query types especially between simple and complex requests.

2. Chatbot Adoption for Customer Service

Nyongesa et al. (2020:106) provide a business-and-customer-focused definition of chatbots as application programs that are powered by AI and use natural processing language to automate internal business processes, customer interactions, and support computer-human communication through voice and text. As a result of businesses going digital, companies develop tools for information retrieval and customer query resolution. Chatbots can understand and respond to customer queries accurately and efficiently by incorporating AI, natural processing language algorithms and machine learning techniques. These intelligent systems enable businesses to provide instant and personalised support, improving customer satisfaction and loyalty (Chen, Lu, Gong, Xiong, 2022:2; Hsu & Lin, 2022:4). Chatbot adoption presents challenges that organisations need to consider. One significant challenge is ensuring the chatbot can handle complex or ambiguous customer queries effectively (Chen et al., 2022:8). Research by Li (2022), highlights the importance of robust intent recognition and dialogue management techniques to understand and respond to customer queries accurately. Human language complexity and the diverse range of customer queries can pose difficulties in achieving high accuracy rates and make it crucial to invest in advanced natural processing algorithms and machine-learning models to improve the chatbot's ability to comprehend and generate appropriate responses (Olujimi & Ade-Ibijola, 2023:3).

Finding the right balance between automation and human intervention is critical in adopting chatbots for customer service. While chatbots can handle a significant volume of customer interactions efficiently, there are instances where human intervention becomes necessary. An article by Conversational AI (2022), highlights the importance of human resource management in chatbot implementation to ensure seamless transitions between automated responses and human support. Organisations must define clear escalation paths and train customer service representatives to intervene when necessary. The ability to seamlessly transfer complex or sensitive queries from the chatbot to a human agent contributes to maintaining service quality and customer satisfaction (Hsu & Lin, 2022:2). Furthermore, organisations must establish effective monitoring systems to identify situations where chatbots may struggle and promptly provide human support (Chen et al., 2022:7). Within the South African telecommunications sector, rule-based chatbots are widely deployed for customer self-service, including balance inquiries, billing issues, Subscriber Identity Module (SIM) card related services, and account management (MyBroadband, 2021). While these chatbots perform well in structured interactions, their performance deteriorates when handling queries that require extended dialogue, nuanced understanding, or real-time decision-making (Caldarini, Jaf & McGarry, 2022:8). This study draws on existing literature by analysing chatbot effectiveness using case reports from TELCO X's WhatsApp chatbot. By assessing chatbot interaction data over four months, this research provides empirical insights into chatbot performance trends, challenges, and potential areas for optimisation in automated customer service. Methodology

The 'Research Onion' model developed by Saunders, Lewis and Thornhill (2007) guides the researcher in this study by providing a systematic approach to structuring the research and elaborates on the research philosophy, research approach, research strategy, research choices and research techniques. This study adopted a quantitative research approach under the interpretivism paradigm. The primary data collection method consists of chatbot use case reports, which include extracted logs of customer-chatbot interactions.

This research study followed a primarily quantitative research strategy that relied on the analysis of chatbot use case reports that were collected over a four-month period. Even though brief qualitative insights are presented, they are exploratory in nature and do not form part of the formal research design. The data set includes categorized interaction records that tagged by outcome types such as success, failure and abandonment. Descriptive statistics were used to measure query completion rates across ten predefined query types. Metrics such as resolution rate, escalation instances and abandonment frequency were analysed.

2.1 Interpretivism as a Research Philosophy

The study adopted the interpretivism paradigm, which emphasizes the subjective nature of the research and the researcher's interpretations (Sanders et al, 2007:108). This approach is essential in understanding "effectiveness" as shaped by users' experiences and expectations and thus aligns with TELCO X's customer service objectives. The researcher analysed chatbot-user interactions and applied objectivism to evaluate the

chatbot's performance from an observable, measurable perspective and gain a comprehensive understanding of the performance.

2.2 Inductive Research Approach

The study adopted an inductive approach to assess the chatbot's functionality and how data from human-chatbot interactions can improve the customer experience. According to Thomas (2006:238), this approach uses quantitative data to generate theories from raw data analysis (Soiferman, 2010:7). The inductive approach allows for theory development grounded in real data from customer interactions and facilitates the construction of an evaluative framework by using collected data to explore how chatbot effectiveness might be theoretically improved to meet customer needs and enhance service.

2.3 Quantitative Method Research Strategy

This study primarily relied on quantitative data and focused on the analysis of use case reports to assess the chatbot's performance. These reports provided numerical data on successful and unsuccessful queries, offering a comprehensive view of the chatbot's effectiveness. This quantitative approach enabled the researcher to evaluate query resolution rates and identify patterns in chatbot performance to contribute to a deeper understanding of how the chatbot meets customer service goals. Document analysis in this study involved the examination of chatbot use case reports, which consist of extracted logs from customer-chatbot interactions. The chatbot is rule-based and offers a standard menu selection for queries, therefore the analysis focused on quantifying the success, failure, and abandonment rates across different query types. This approach allowed the researcher to assess the chatbot's performance by analysing the frequency of successful query resolutions and identifying areas where the chatbot failed to meet user needs. The analysis of these logs provided a quantitative basis for evaluating the chatbot's effectiveness in resolving customer queries.

2.4 Ethical Considerations

All applicable ethical considerations were addressed by obtaining a permission letter from TELCO X's Information Privacy Office to grant the researcher authorisation to collect primary data. The letter was subsequently submitted to the UJ Ethics Committee for formal approval and documentation. This research study adhered to all the ethical guidelines of The University of Johannesburg's Ethics Committee. An alias (TELCO X) is used to maintain anonymity for the telecommunications service provider.

3. Findings and Discussion

The chatbot achieved a 55% success rate which is consistent with the findings from Adams (2021). Adams (2021) reported that there is a moderate performance amongst rule-based systems on context-specific tasks. Whereas complex queries such as SIM swaps have a higher failure and abandonment rate. This reaffirms prior research conducted by Hsu and Lin (2020) regarding task complexity affecting chatbot usability. The researcher obtained chatbot conversation reporting from TELCO X for analysis. The dataset spans four months (December 2022 to March 2023) and contains information on crucial chatbot performance metrics across different use cases. Each month's data is structured in terms of the following variables:

- Use Case – The task or query type the chatbot addresses.
- Abandoned – The number of instances where users abandoned their interaction with the chatbot.
- Failed – The number of instances where the chatbot could not resolve the query or task.
- Success – The number of queries or tasks successfully resolved by the chatbot without further intervention.
- Grand Total/Total – The total number of interactions for each use case, representing the sum of abandoned, failed, and successful cases.

Key findings provide insight into the chatbot's performance across various use cases and highlight strengths and areas for improvement. The analysis focuses on success, abandonment, and failure rates over four months and examines trends to identify opportunities for enhancing the chatbot's design and functionality.

3.1 Success Rates

"Frequently Asked Questions" (FAQs) and "Get PUK" have a score of 100% and the highest success rate in all months compared to other use cases. This finding demonstrates that the chatbot effectively answers frequently

asked questions and provides subscribers with PUK numbers, suggesting that these use cases are well-suited for automation and that the information retrieval process works efficiently. “See Balance”, “Targeted Collection”, and “TC-Pay Invoice” consistently show a significant success rate, with an average of 85%, 98%, and 78% of queries successfully resolved, respectively. However, there is also a notable portion of abandoned and failed interactions for “See Balance” in January and March and “TC-Pay Invoice” in March. This indicates that while the chatbot can resolve many users' balance and invoice payment queries, some find the process challenging or incomplete. “Rate Service”, “Invoice and Statement”, “Buy Airtime”, and “Cancel Subscription” show moderate success rates between 50% and 78% on average. Though no failures are reported for “Rate Service”, the relatively high abandonment rate suggests that users may not be experiencing technical failures but rather abandon the interaction due to perceived irrelevance or lack of interest. “Buy Data”, “SIM Swap”, “Change Spend Limit”, “TC-Promise to Pay”, and “Block and Unblock” have the lowest success rates and the highest failure and abandonment rates, with success rates between 7% and 40% on average. These use cases are likely more complex or involve more detailed steps that may not be easily handled by the current design of the chatbot.

3.2 Abandonment and Failures

As previously examined, “Buy Data”, “SIM Swap”, “Change Spend Limit”, “TC-Promise to Pay”, and “Block and Unblock” have the lowest success rates and the highest failure and abandonment rates. The combined failure and abandonment rates for these use cases in December, January, February, and March are 21%, 32%, 41% and 56%, respectively. “SIM Swap” and “Buy Data” have a significant number of failed and abandoned interactions recorded each month. Consequently, both use cases have the highest failure rates; notably, 53% and 44% were recorded in February and March for “SIM Swap” and “Buy Data”, respectively. The high failure rates could indicate that the chatbot experiences technical limitations in handling SIM swaps and data purchases or that the user is dissatisfied with the steps involved. “Change Spend Limit”, “TC-Promise to Pay”, and “Block and Unblock” show a high percentage of abandonment rates each month. However, the recorded number of total interactions (success, failed, abandoned) for each use case is below 400. This number is insignificant relative to an average total of 85 550 interactions for the chatbot for the four months. The number of interactions may reflect user service plans because some use cases are limited to post-paid customers. “SIM Swap” and “Buy Data” show abandonment rates between 31% and 52% across the months. This suggests that users may begin the transaction process of purchasing data or requesting a sim swap but fail to complete the tasks due to confusion, technical issues with the chatbot, or overall dissatisfaction.

3.3 Monthly Trends

Success rates across all use cases generally remain stable over time. However, March shows a slight improvement in success rates across the use cases and indicates possible incremental improvements in the chatbot’s performance or better user understanding of the chatbot. Buy Data and SIM Swap have more volatility in their success and failure rates. As a result, the trend of abandonment and failure for these use cases fluctuates monthly, suggesting the two use cases as priority areas for improving the chatbot design and functionality.

3.3.1 December 2022

The highest success rates were recorded for “See Balance” and “FAQs,” with both use cases showing high user engagement and effective resolution. “Rate Service” also displayed strong success metrics, although the significant number of abandoned sessions suggests that while users are interested, some might exit the chat before completion. Low success rates were observed in "SIM Swap," indicating potential challenges with this service, possibly due to complex processes or unmet use expectations.

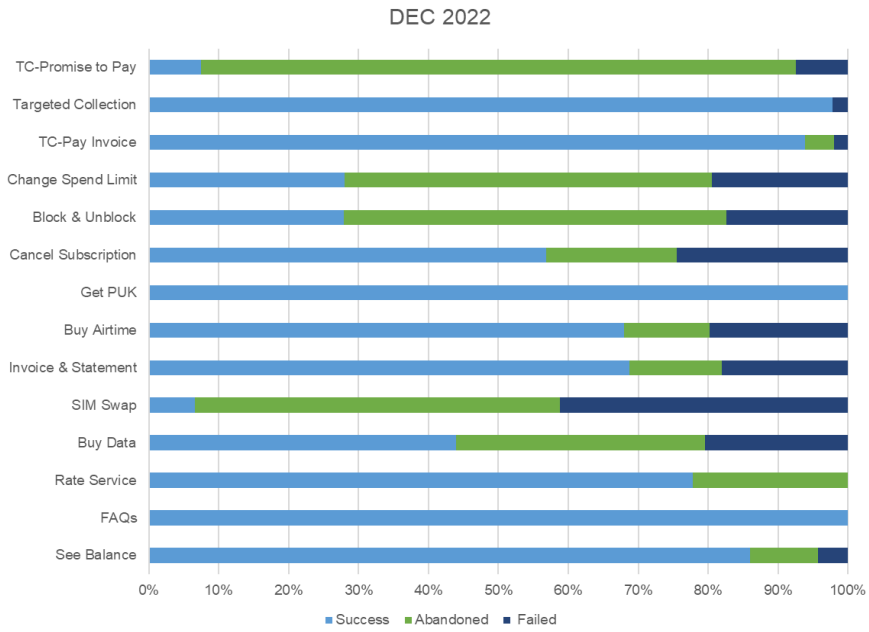


Figure 1: Stacked bar chart depicting December 2022 customer-chatbot interactions for use case analysis.

3.3.2 January 2023

"FAQs" and "See Balance" remained popular queries and showed high success rates, though there was a slight reduction in success rates compared to December. "Buy Data" saw a slight reduction in abandoned cases, but "SIM Swap" maintained high abandonment and failure rates and indicated ongoing user difficulties with this process. An improvement was noticed in "Invoice & Statement" with a slight increase in successful chatbot performance, possibly due to backend adjustments or user familiarity.

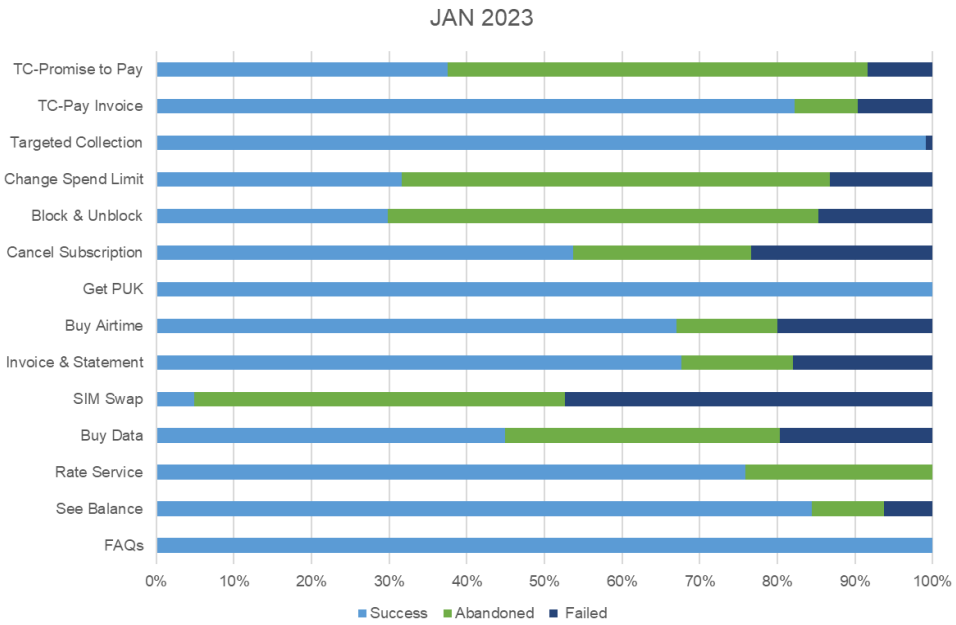


Figure 2: Stacked bar chart depicting January 2023 customer-chatbot interactions for use case analysis.

3.3.3 February 2023

User engagement with "FAQs" remained consistently high, maintaining its position as the most frequently used service with high success rates. "Rate Service" and "See Balance" maintained high success rates, although "SIM Swap" and "Buy Data" indicate a trend of high failure and abandonment rates. Increased success rates in "Invoice & Statement" and "TC-Pay Invoice" suggest a gradual improvement, but these still displayed a notable number of failures and indicate the need for additional enhancements.

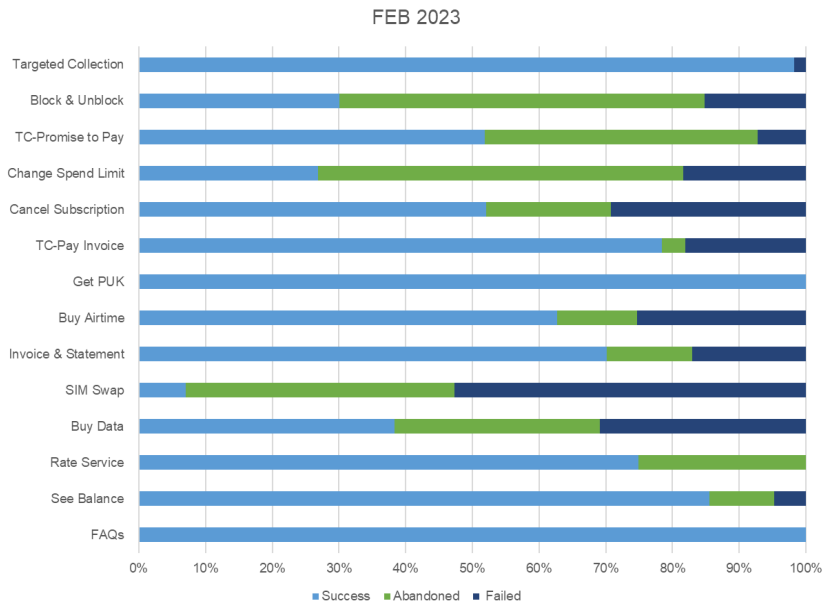


Figure 3: Stacked bar chart depicting February 2023 customer-chatbot interactions for use case analysis.

3.3.4 March 2023

"FAQs" indicate an increase in usage once again by maintaining high success rates and affirming its role as a key support feature. "See Balance" indicates a slight reduction in success but maintained high user engagement. "Rate Service" usage and success rate remained stable, while "Invoice & Statement" and "SIM Swap" continued to experience high failure and abandonment rates and indicate ongoing issues that could benefit from user interface adjustments or support resources. Notably, "Targeted Collection" saw an increase in successful resolutions in March, which could be due to process improvements or targeted interventions.

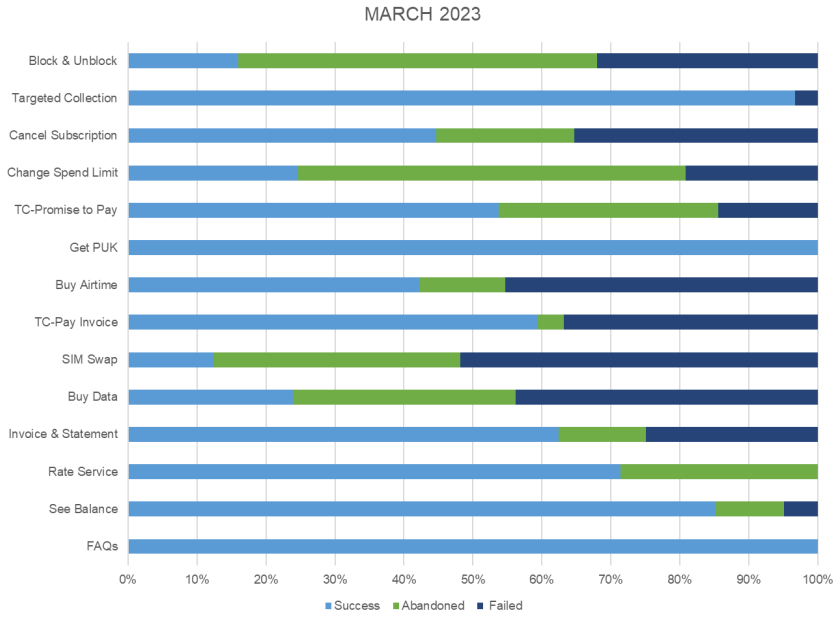


Figure 4: Stacked bar chart depicting March 2023 customer-chatbot interactions for use case analysis.

3.4 Qualitative Insights

While the provided data is primarily quantitative, the following qualitative insights can be inferred based on performance patterns:

- User Frustration or Complexity in Certain Tasks: The high abandonment and failure rates for select use cases suggest that these tasks may be too complex for the chatbot to execute or that users

experience challenges in the interaction process. This could be because of poor natural language understanding or unclear instructions from the chatbot.

- Efficiency in Routine Queries: The high success rate for use cases such as "FAQs" and "See Balance" suggests that the chatbot effectively handles routine, straightforward queries. Users can get the information they need promptly and without human intervention, consequently improving user satisfaction in these cases.
- Potential for User Dissatisfaction in Complex Use Cases: The more complex queries, such as buying data and doing a SIM swap, lead to higher failure and abandonment rates and could signal user dissatisfaction. Users may require additional support or explicit guidance from the chatbot or human intervention in these use cases.

3.5 Categorisation of Findings

The researcher categorises the research findings based on the chatbot's performance in handling different tasks. This categorisation highlights routine and complex tasks, with each category presenting the chatbot's success, failure, and abandonment rates. The researcher interprets user engagement, chatbot effectiveness, and actionable insights to improve functionality, particularly in managing complex queries.

Table 1: Categorisation of Findings

Category	Use Case	Key Metrics	Interpretation	Action/Insight
Routine Tasks	See Balance; FAQs; Rate Service; Get PUK; Targeted Collection; TC-Pay Invoice.	Success Rate: **High** Failure Rate: **Low** Abandonment Rate: **Low**	These simple tasks follow predictable patterns, allowing the rule-based chatbot to provide accurate responses efficiently.	The chatbot is well-optimised for these tasks, and minimal adjustment is needed.
Complex Tasks	SIM Swap; Buy Data; Change Spend Limit; TC-Promise to Pay; Block and Unblock.	Success Rate: **Low** Failure Rate: **High** Abandonment Rate: **High**	These tasks involve multi-step processes or require a more nuanced interaction. The chatbot needs help managing these tasks effectively due to the limitations of its rule-based design, which needs more flexibility to adapt to dynamic or multi-step queries.	The chatbot may require redesigning or additional rules to handle complexity and reduce task abandonment and failure. High abandonment and failure rates also indicate a need for more precise instructions or smoother navigation through complex tasks.

4. Recommendations

Based on the findings and the identified gaps in query resolution, the following recommendations are proposed to enhance the chatbot's effectiveness:

4.1 Enhance AI and Linguistic Capabilities

The chatbot's natural language processing capabilities need improvement to understand user intent better and handle diverse phrasing. For complex queries, the chatbot should be equipped with more advanced AI capabilities to guide users through multi-step processes seamlessly. This includes recognising the context of user inputs and offering tailored responses.

4.2 Redesign Interaction Flows for Complex Tasks

The chatbot's current design for complex tasks requires a more intuitive flow. Simplifying the steps and providing more explicit instructions will help reduce user confusion and abandonment. Ensuring that users receive step-by-step guidance will improve task completion rates.

4.3 Integrate Human Assistance More Effectively

Complex queries often require human intervention, and the chatbot should offer a seamless transition to a human agent when necessary. The current system does not consistently provide this option, which can lead to frustration. By incorporating a more accessible and timely escalation process, the chatbot can ensure that users are supported when automated solutions fall short.

4.4 Improve Information Retrieval for Complex Queries

The chatbot's information-retrieval process needs to be enhanced for use cases with high failure rates. Users can be better supported throughout the interaction by expanding the chatbot's knowledge base to cover more complex queries and provide more detailed responses. This will reduce the need for manual intervention and increase the likelihood of task completion.

4.5 Leverage Customer Feedback and Behaviour Insights

To improve the chatbot's functionality, continuous analysis of customer behaviour data, including common drop-off points and failure patterns, should be used. Regular updates to chatbot flows based on customer feedback will help address gaps in task performance and lead to a more efficient system.

4.6 Expand and Optimise Task Capabilities

The chatbot's current strength is in handling routine tasks. To increase its overall effectiveness, the system should be expanded to cover a broader range of use cases, especially those that involve complex decision-making. By optimising the chatbot's capabilities to handle these tasks, TELCO X can reduce customer frustration and improve satisfaction.

5. Conclusion

This research study analysed how a rule-based WhatsApp chatbot resolves different categories of customer queriers. The chatbot was effective in addressing simple transactional tasks but consistently underperformed in more complex queries. The originality of this study lies in its application of real-world usage logs ands query classification to assess rule-based chatbot limitation in customer service contexts. The WhatsApp-based chatbot proves effective in resolving routine customer queries but struggles with complex tasks, which require significant improvements in AI capabilities, information retrieval, and user guidance. While the chatbot demonstrates its potential for handling frequent and straightforward queries with high accuracy and speed, its limitations in addressing intricate customer needs highlight areas where enhancements are critical. To fully realise the potential of conversational chatbots in customer service, the recommendations provided will help TELCO X address the identified resolution gaps and deliver a more comprehensive and satisfying user experience. Implementing these improvements will ensure the chatbot evolves into a more versatile and reliable tool, capable of effectively resolving both simple and complex customer queries.

Ethics Declaration

Ethical Clearance has been obtained for this study and has been reviewed by the School of Consumer Intelligence and Information Systems at the University of Johannesburg.

AI Declaration

No AI tools were used in the creation of this paper.

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Brand Development in Early-Stage Technology Startups: An Effectual Approach

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Abstract: In this study, we explore the brand development processes in early-stage technology startups, focusing on corporate identity, brand identity formation and decision-making. While most of the branding literature pertains to established firms, branding can provide significant competitive advantages to startups, enhancing their chances of survival. However, given the high uncertainty, resource constraints and dynamic market conditions typical of early-stage startups, traditional branding strategies may not always be suitable. Instead, an effectual approach may be more suitable. Drawing on the branding literature and entrepreneurial decision-making theories, particularly Sarasvathy's (2001) effectuation framework, in this study, we examine how startups shape their brand identity. Data were collected through in-depth interviews with eight key informants from five technology startups and two experts in branding and entrepreneurship. The findings reveal that entrepreneurs play a crucial role in early branding decisions, with brand identity often being closely tied to the entrepreneur's personal vision, values and networks. With startups frequently adjusting their brand based on market feedback, several of the informants pointed to the importance of customer interaction as well as social media as a vital tool that enables direct customer engagement and serves as a cost-effective branding platform. Furthermore, startups often develop their brands iteratively, making real-time adjustments. On one hand, this flexibility allows them to navigate market uncertainties; on the other, it presents challenges, such as inconsistent branding. Finally, in this study, we find that while some branding adaptations are intentional, others result from external pressures or resource constraints. This research contributes to the literature on branding and entrepreneurship by illustrating how startups balance strategic branding efforts with the realities of early-stage business development.

Keywords: Startups, Branding, Strategy, Effectuation, Identity

1. Introduction

The early phases of new ventures are demanding. The situation is uncertain, resources are limited, and unforeseen obstacles and challenges are likely to arise. In Norway, only one in four startups exists after five years (SSB, 2024). There is limited research on branding among startups, but empirical studies suggest that startups that prioritise branding in the early phase perform better than their competitors that do not (Berthon et al., 2008). The purpose of a brand is to create a strong, recognisable identity that stands out in the market and forms emotional bonds with the target audience. A strong brand inspires trust, attracts customers, and simplifies communication with customers and investors (Aaker, 2011). At the same time, branding is resource intensive, and during the startup phase, it can be easy to deprioritise branding.

The aim of this paper is to investigate branding and brand development processes in early-stage technology startups, focusing on the entrepreneurial decision-making process. The paper is organized as follows: We first briefly review the relevant literature on startups and branding. Then, we present the empirical study, including the method, findings, and analysis. Finally, we conclude by providing theoretical and managerial implications as well as limitations of the study. The study contributes to the literature on the branding and brand strategies used by entrepreneurs in the early phase of startup creation.

2. Theoretical Framework

The literature highlights several reasons why brand building is profitable. It is well established in the brand literature that brands can help clarifying identity and position in the market, enhance loyalty, and contribute to capturing the attention and resources of investors and potential partners (see(Aaker, 2011) or similar). In a study of 195 start-ups, (Rus et al., 2018) concluded that the respondents found brand building to be the most critical element of a successful business strategy, followed by product development and organisational development.

2.1 Branding

The traditional brand-building literature emphasises the planned, or causal, development of brand strategies. In the early phase of startups, in which uncertainty is high and resources, knowledge, and expertise regarding

brands are limited, such a methodology can be inappropriate and challenging to implement (Bresciani and Eppler, 2010). Startups rarely have the resources to prioritise all desirable activities; thus, opportunity assessment is vital (Mainela and Puhakka, 2009, Sarasvathy et al., 2003). In the early phases, opportunity assessment and decision-making are both closely linked to the entrepreneur or entrepreneurial team (Acharya and Berry, 2023, Rode and Vallaster, 2005, Tobiassen et al., 2022).

In a widely cited study Sarasvathy (2001) found that experienced entrepreneurs tended to use a more intuitive and effectual decision logic than the step-by-step method described in strategic branding literature. Effectuation is based on five main principles: starting with available resources rather than stant goals, limiting risk by not investing more than one can afford to lose, forming partnerships to leverage others' resources and ideas, viewing unexpected events as opportunities and making decisions based on controllable factors rather than attempting to predict the future. An effectual approach involves taking small risks, seeking collaboration with partners who can influence the path forwards and being flexible in the face of unforeseen events (Read and Sarasvathy, 2005, Sarasvathy, 2001, Sarasvathy and Dew, 2005); see Figure 1). This approach is particularly useful in high-uncertainty situations, in which the future is difficult to predict. In such contexts, acting and adapting along the way are more important than following a predetermined plan.

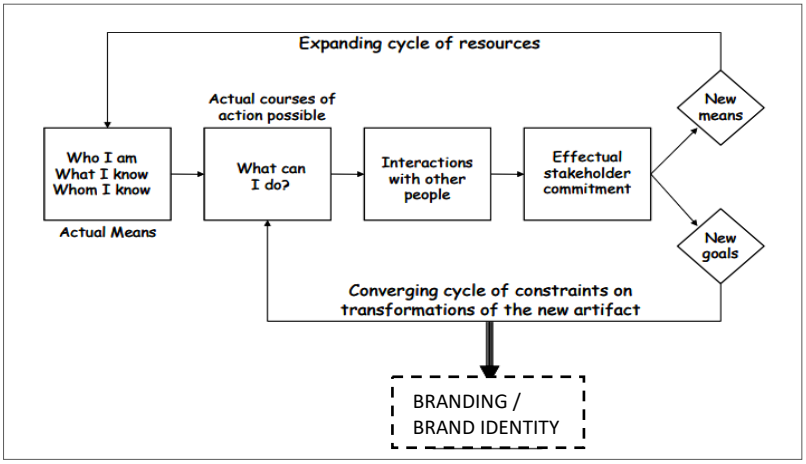


Figure 1: The effectual process, adapted from Sarasvathy and Dew, 2005: 543. 'Branding /Brand Identity' replaces the original 'New Markets' as the artefacts in focus in this study.

Both the traditional/causal model and effectuation approach emphasise the importance of identity, goals/possible goals, and collaboration, but they have different perspectives on these phenomena. The major difference lies in the fact that the causal model begins with a goal and a plan for achieving it while the effectual model begins with an opportunity assessment and moves through a process in which goals and means are adjusted along the way.

2.2 Corporate Branding and Brand Identity

Defining a brand identity that can contribute to positioning the brand is traditionally considered the first step in brand building (Kotler et al., 2019). The advantage of having a clear idea of brand identity from the beginning is supported in the entrepreneurship literature (Bresciani and Eppler, 2010, Rode and Vallaster, 2005). A clear understanding of the startup's identity (who you are) affects the perceived opportunity space and, thus, the ability to acquire resources crucial for building a startup.

In a study of how entrepreneurs choose corporate brand, researchers showed that most entrepreneurs use two main strategies: cognitive and emotional naming (Engel et al., 2022). Cognitive naming implies that the name should convey what a business does. Emotional naming focuses on the feelings associated with a company or brand. According to Engel and colleagues' studies, serial entrepreneurs tend to consider both strategies when deciding on a brand name. First-time founders, on the other hand, focused mainly on cognitive naming, emphasising that the name should describe the product informatively. A consequence of this is that these entrepreneurs may miss out on the associative value of a name that builds the emotional part of a brand (Engel et al., 2022). From the literature, we know that emotions are a crucial part of brand identity (Jain, 2017) and entrepreneurial decision-making (Brundin and Gustafsson, 2013).

The entrepreneur's central role in the development of the new business ties the early corporate brand identity to the entrepreneurs' personal values and visions (Pakura and Rudeloff, 2023, Rode and Vallaster, 2005, Shi, 2019). Another characteristic of startups is that brands are developed in interaction with stakeholders (Chaudhri et al., 2022). In particular, the interaction with customers is considered both a source of insight for the development of products/services/brands and an opportunity to build trust and loyalty in the market (Pakura and Rudeloff, 2023, Chaudhri et al., 2022). Chaudhri et al. (2022) describe the process of brand development as a negotiation between the startup and various stakeholders, while Roshanzamir and colleagues (2018) view it as a co-creation process. In both cases, the interaction between the company and stakeholders is reflected in the development of the brand and brand identity.

Studies show that changing or adapting the brand's name, identity, and purpose is common throughout the early phase (Bresciani and Eppler, 2010, Rus et al., 2018). In contrast to traditional recommendations to first develop and then launch, Bresciani and Eppler (2010) conclude, in their study, that it is beneficial for startups to be flexible in terms of brand development, testing and adjusting along the way. In a comprehensive study conducted in Slovenia, Rus and colleagues found that most startups began with a clear vision at establishment but that this was changed and adapted as the startups moved into new phases (Rus et al., 2018). Some argue that changes are not necessarily intentional or desired. They can also be a consequence of lacking resources, necessitating cuts or changes in plans and activities (Roshanzamir, 2018).

3. Methodology

We chose to perform an exploratory, multiple-case study to gain insights that are not available in large-sample studies (Yin, 2009). This approach is well suited to examining issues in a realistic context and combining inductive and deductive research (Eisenhardt, 1989).

3.1 Data Collection

Data collection was conducted at two points in connection with two student assignments supervised by one of the authors. Informants were recruited via direct email. The inclusion criteria for startups were that they were technology companies, had survived the first critical year, had reached a stage with paying customers and had a clear brand identity (a website and a visible corporate brand with a logo/trademark at a minimum). Additionally, at least one of the entrepreneurs was required to still be employed at the company at the time of the interview. This resulted in interviews with eight informants from five startups. Further, two experts working in a startup accelerator and a consulting company specialising in branding were included as informants. An overview of the informants and companies are given in table 1.

Semi-structured interview guides were used to ensure consistency (Yin, 2009). The interviews lasted between 30 and 80 minutes. To strengthen validity and avoid challenges related to unintended data reduction, the interviews were recorded and then transcribed.

Table 1: Overview of companies and informants, anonymized

	Company Information	Entrepreneurial Experience	Number of Informants
Pinnacle Innovations	Digital service. B2B. Established 2017, 16 employees in 2023.	Serial	2
Novatech Enterprises	Digital physical service/robots, health science. B2B, B2C. Established 2015, 19 employees in 2023	Serial	1
Elevate Dynamics	Digital service, environmental sustainability.B2B Established 2018, 10 employees in 2023	Serial	1
Yellow Horizon	Digital service, arts/media. B2B, B2C Established 2021, 5 employees in 2023	First time	2
Greenline Ventures	Digital service, finance. B2C Established 2021, 4 or less employees in 2023	First time	2
Expert 1	Accelerator	Advisor	1
Expert 2	Brand consultants	Advisor	1

3.2 Data Analysis

Only some of the questions and answers from the original interviews are used as data basis for this paper. The authors specifically coded and analysed the data used in this paper based on the transcriptions.

To enhance validity and reliability and to minimise personal bias during interpretation, a researcher triangulation strategy were employed during the coding and analysis process (Yin, 2009). Also, an individual-group approach was used to ensure a comprehensive perspective. Hence, initially each author individually read the transcribed interviews and made preliminary notes. We then convened to discuss and further interpret the data, following the principles of thematic analysis (Braun and Clarke, 2006).

4. Findings and Discussion

4.1 Corporate Brand and Brand Identity

To be registered as a business, a company must have a name. In our material, we find that the entrepreneurs in the startups have comprehensively reflected on the names chosen, though not necessarily by following a textbook strategic process. For example, the informants from YellowHorizon report that it was challenging to balance the fear of choosing the 'wrong' name against the fact that the decision could not be postponed:

> *We considered a lot of different options. We bought many domains, just to have different alternatives (…) I think the entrepreneurs simply had to settle on a name. It was a brainstorming session, and then, this was what we agreed on.*

The informants are aware of the associations the brand has and creates. The informant from NovatechEnterprise expresses this in the following way: 'The brand has been something they (the entrepreneurs) have been extremely conscious of from the beginning.'

Most informants preferred a name that clearly explained the company's function, aligning with studies showing that descriptive names facilitate market communication, especially in the early phase, when the brand is unknown (Engel et al., 2022, Juntunen, 2012, Negassa and Japee, 2022). In our study, NovatechEnterprise is a good example, with the unanonymised real-world corporate brand name literally describing the product/service's purpose. The NovatechEnterprise informant notes that 'Branding for NovatechEnterprise is about demonstrating expertise, that they know what they are talking about, when they address the need the product fulfils'. GreenlineVentures, YellowHorizon and ElevateDynamics also chose names based on their services' intended customer benefits, though these are less intuitive. Thus, the informants in our study are conscious of the associations their brands create. Several point to the importance of having and maintaining a fundamental identity that allows customers and stakeholders to recognise them even when they make changes in their business and/or physical artifacts.

Language is a key tool for creating specific associations and feelings. YellowHorizon, for example, aims for a perception of personal relationships and closeness, using language to evoke these feelings both directly, in relation to the service and brand, and indirectly, through providers using the platform. Some informants stress that the name should appeal to customers emotionally, serving both cognitive and emotional functions (Engel et al., 2022). YellowHorizon illustrates this dual function, describing its (real) name as 'playful and cool' (emotional) and 'telling what we do' (cognitive). Unlike Engel and colleagues, we found no difference between companies with first time entrepreneurs and serial entrepreneurs, potentially due to our limited sample size.

Several of the startups report that they have found identity to be essential in the early stages, when the brand is shaped and developed. One of the informants from YellowHorizon states the following:

> *Things are constantly changing, so the visual identity must also have room to evolve. Yes, because we are a startup, where things are happening and few things are set in stone, it is nice to have an identity that makes us recognisable but also allows for change without it being a shock every time we do something new. Yes, it's about finding that balance, where it must resemble us but we also allow us to try something new.*

4.2 Brand-building Methods

The expert informants both believe that some form of planning is important. Expert2 has faith that methods can be useful for branding and also make it easier to 'tidy up brand strategies'. He refers to various frameworks that

can provide the company with an overview, or a holistic picture. Which method the company chooses is not especially important but having a method 'and not just randomly decide to do X without really knowing why' is. Furthermore, Expert1 notes the importance of being aware of what the company does differently than its competitors. Both agree that focusing on this is more important than dedicating excessive time to font, logo, and similar elements, aligning with the practices of many larger, established companies that prioritise brand recognition. Expert1 believes there are certain steps you can take in branding, particularly concerning identity. In his opinion, identity can serve as a consistent thread, making the startup recognisable despite changes in brand visuals. He states, 'It's okay to make changes when you have a direction.'

The companies do not appear to have used specific methods or frameworks in their branding efforts. However, the analysis shows that startups are aware of what distinguishes them from established competitors, even if they have not conducted extensive analyses on paper. For example, they may have considered what others have done and been inspired by it. Informants from several startups noted the necessity of flexibility in the early phase as the brand evolves. An informant from YellowHorizon mentions that 'Things change all the time, so the visual identity must also have room to develop.' While none have changed their names, several have adjusted their visual profiles after gaining more insight into their identity and aspirations, becoming bolder in their market positioning. An example provided by an informant from PinnacleInnovation is as follows:

> *In the autumn of 20xx, we went through a rebranding process where we worked on defining the character of the company. We changed the entire visual expression, replaced the logo, colours, etc. We considered changing the name but did not find a better alternative (…). The first visual profile was very basic. We looked at how others had done it and designed the website in the same way as others in the industry. Now, we have tried distinguishing ourselves from the others. After the rebranding, the number of signings has decreased, but their quality has increased because they know more about us and what we stand for before they sign.*

Startups often draw inspiration from others. An informant from GreenlineVentures mentions, 'We've borrowed "best practices" to avoid reinventing the wheel (…), following a "random walk" strategy.' As businesses gain insight, new ideas about the brand name and its associations may arise.

The informants in this study report that changes occur continuously through trial and error along the way rather than because of planning. Thus, they face challenges within an effectual perspective, in which the evolving situational understanding impacts company goals and means, thus affecting their identity. This aligns with studies showing that adaptations of a brand's name, identity and purpose are common early in the startup process (Bresciani & Eppler, 2010; Rus et al., 2018).

Companies also face challenges regarding the time and resources needed to develop robust plans and systems, often lacking the necessary time in a startup environment. An informant from YellowHorizon says the following:

> *I would say it's a bit of a cliché that there are no systems in a startup. In a startup, everything is burning all the time. If you sit down and make a map of all the fires, everything goes up in smoke. You just must go and extinguish them. That's the approach we have.*

4.3 Insight Processes

Several informants report that the entrepreneurs / early phase startups lacked expertise in brand building and market communication. Some chose to strengthen their own teams by recruiting individuals with marketing expertise, while others used consultancy help. ElevateDynamics, which relies heavily on market communication through images, was among those that chose to strengthen internal expertise and, early on, hired someone responsible for visual expression 'because we want visibility without spending too much money and are focused on publishing the right images and using the right design'. The general experience is that marketing is difficult to outsource and cannot replace internal engagement. According to our informants there is a need for decision-makers to be closely involved with the brand and for those with in-house product expertise to be closely involved in the implementation process.

Recent research shows that it is advantageous to involve employees in the startup in marketing efforts, as participation and informed knowledge contributes to business and profitability (Fürst et al., 2023). Both expert informants in our study work closely with startups in the early phase and share this view. They think it is beneficial for the entire team in the startup to participate in the early process because this creates an internal commitment to what the company is doing, which is important for startups. Expert1 says the following:

> (…) There are often so few employees that everyone is involved, but of course, when you grow larger, you must start thinking more strategically about it. What is important is to gather information and insights from all the different departments you work with.

All the informants included in this study highlight the need to involve customers in brand development in the early phase. Close collaboration with customers can help the brand resonate with the target audience. By involving customers, it is possible to gain insight into their needs and preferences. This insight can both result improved products and reduce the risk of errors. Both experts point to customers. Expert1 says, 'If you don't have some form of channel where you can get feedback from customers, you base everything just on guessing and your own assumptions' and further emphasises that startups should not plan an extensive brand strategy too early, both because changes will occur along the way and because this will require too many resources. At the same time, they believe it is important for the company to recognise that everything it does influences the brand. Expert1 says:

> *What customers think about you is what I see as your brand, and I see that as one of the most important things you work on in the beginning. I understand that many do not have the opportunity to spend enough money and energy to run a large trademark campaign, while your brand is something you build every day regardless. The way you work with customers, customer relationships, the way you are visible, or everything you do, falls under your brand.*

Our findings are in line with previous research on brand building in the early phase, which shows that early insights from the market can reduce the risk of errors by allowing better-informed decisions (Kusi et al., 2021, Hisrich and Ramadani, 2018). Informants from all five companies acknowledge the importance of customer contact for brand development. However, the extent of customer involvement and how early it begins varied.

5. Conclusions

5.1 Conclusions and Implications

The aim of this study was to investigate branding and brand development processes in early-stage technology startups, focusing on the entrepreneurial decision-making process. The informants from the five startups included in this study acknowledge the importance of a brand/an identity and have been working on brand development since their startups' inception. In the early stages, the entrepreneurs behind the businesses play a significant role. Our findings indicate that entrepreneurs are crucial in promoting corporate identity and making initial brand-related decisions, such as choosing a name and defining what the brand represents. This is in line with the findings of earlier studies that tie early corporate brand identity to entrepreneurs' personal values and visions (see Pakura and Rudeloff, 2023; Rode and Vallaster, 2005; or Shi, 2019, among others). In our study, we found that brand identity development, in the early phases, tended to be a collaborative effort involving not only owners but everyone in the company and/or close to the company. This inclusive format may be a coincidence in terms of the selection of study objects or be related to their origin in Norway, which is known for flat hierarchies, a high level of trust, collaboration, and employee involvement in decision-making processes (Gustavsen, 2011).

As the brand begins to take shape, it can be challenging for entrepreneurs to remain closely involved in the branding process. This is partially because they feel they lack the necessary expertise and partially because they have many other urgent tasks. Several informants mentioned the lack of time and resources as one of the largest challenges in the early phase. However, there is a consistent belief among our informants that brand building is central to a company's development and survival and, therefore, cannot be outsourced. Even when external expertise and consultancy services are utilised, our informants regard the startup remaining closely connected to customers, investors and other sources of insight impacting the brand as crucial. This is in line with earlier studies describing the process of brand development as one of negotiation (Chaudry et al., 2022) and co-creation (Roshanzamir et al., 2018) between the startup and various stakeholders.

Previous studies on decision-making patterns show that while traditional leaders typically follow a causal logic, emphasising analysis and planning before action, entrepreneurs tend to adopt an effectual logic, in which resource prioritisation occurs more dynamically as opportunities arise or are created (Read and Sarasvathy, 2005, Skarderud and Kubberød, 2016). Our expert informants support this view. A startup has many tasks to handle, and limited initial insight and a steep learning curve, along with a changing understanding of the situation, in the early phase affect what is possible and advisable. Both experts believed that startups would

benefit most from focusing on the customer and inviting them into a simplified strategy process centred on testing and adaptation. A young company that has not yet found its product–market fit should be more flexible than what is outlined in a planned brand strategy. This is supported by prior findings (Bresciani and Eppler, 2010, among others).

The startups included in this study have, in line with Sarasvathy's initial proposal (2001; 2003) and many later empirical studies, adapted an effectual approach during the brand development processes. Their rationale is that this is the most sensible use of resources and the best way to gain insight when starting from scratch. It appears that serial entrepreneurs have a somewhat more conscious approach to this than first-time entrepreneurs, but the data are too limited to draw such a conclusion. One possible explanation might be that while serial entrepreneurs are more inclined to trust their intuition and have a broader network they know how to use, the first-time entrepreneurs have less experience and are more inclined to follow a textbook approach. The influence of experience in the entrepreneurial process should be further explored in future studies

The companies included in this study were all interviewed in an early stage. Studies have showed that the approach taken may change as the decision-making environment becomes less uncertain and the company becomes more established (Kusi et al., 2021, Read et al., 2009). It could therefore be interesting to conduct a follow-up study to determine how the companies conduct brand decisions when they are past the initial start-up phase.

5.2 Limitations

The study is based on a small sample in a Norwegian context. In future research, it is recommended to test the relationships in other contexts and examine the potential differences between B2B and B2C approaches, which were not investigated in this study

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Ethics Declaration

Informed consent was obtained from all informants at the time of the interviews in accordance with Norwegian scientific regulations. All information is anonymised and none of the information is sensitive.

AI Declaration

AI has been used for an initial translation of the quotes from Norwegian to English. We also used AI to develop the title.

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Understanding Brazilian Migrant Entrepreneurship in Portugal: Motivations, Barriers, and Policy Implications

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Abstract: This study examines the entrepreneurial activities of Brazilian migrants in Portugal, focusing on their motivations, challenges, and policy implications. It addresses two central research questions: What are the key motivations and barriers for Brazilian migrant entrepreneurs in Portugal? And how can policy interventions enhance their business success? Based on 58 interviews and secondary data, the study uses thematic qualitative analysis. The findings are grouped in two entrepreneurial profiles: opportunity-driven and necessity-driven. Opportunity-driven entrepreneurs typically migrate with capital, prior experience, and strategic business plans. They often launch scalable ventures in sectors such as consulting, IT, and gastronomy, leveraging networks, education, and foresight. Conversely, necessity-driven entrepreneurs transition into self-employment after low-skilled employment, pushed by limited job prospects and Portugal's relatively low minimum wage (under €900). These ventures are concentrated in labour-intensive, low-margin sectors like retail and construction, often facing barriers related to financing, bureaucracy, and informality. Findings show that both groups are motivated by economic instability, violence, and a declining quality of life in Brazil. Portugal is perceived as a safe and accessible destination, offering better education, public services, and long-term stability. While opportunity-driven entrepreneurs benefit from EU market access and time zone advantages, necessity-driven ones rely heavily on informal networks and face greater difficulty in formalizing their businesses. Despite these disparities, Brazilian entrepreneurs contribute significantly to the Portuguese economy by generating employment, revitalizing neighbourhoods, and enriching cultural diversity. The study underscores the importance of differentiated policy frameworks: European market integration and investment incentives for high-growth ventures, and simplified regulations, microcredit, training, and community-based support for subsistence-level businesses. These insights are valuable for policymakers, incubators, and scholars focused on migrant entrepreneurship and inclusive development. Addressing structural barriers can further unlock the entrepreneurial potential of Brazil's growing diaspora in Portugal.

Keywords: Migrant Entrepreneurship; Global Mobility; Brazilian Entrepreneurs; Economic and POLICY FACTORS; BUSINESS ENVIRONMENT in Portugal

1. Introduction

Migrant entrepreneurship plays a vital role in driving economic growth, job creation, and social integration in host countries (Dheer, 2024). In 2023, the number of foreign residents in Portugal grew by 33.6% compared to 2022, reaching a total of 1,044,606 individuals holding a Residence Permit. In recent years, the country has seen a rise in immigration from Asian countries, including India, Nepal, Bangladesh, and Pakistan. Brazilians represent the largest immigrant group, accounting for 368,449 residents—equivalent to 35.3% of the total foreign population.

Entrepreneurship emerges as a central strategy for the economic integration of many migrants, drawing on resources such as social capital, creativity, and cultural adaptability (Malheiros & Padilla, 2015; Sarkar et al, 2022). Data from AIMA (2023) indicate that immigrants contribute significantly to sectors such as transportation (e.g., taxis, delivery services) and technology, but face barriers including limited access to formal financing, excessive bureaucracy, and ambiguous media representations (Silva et al, 2024). Moreover, public policies such as the Golden Visa and microcredit programs, while aiming to promote economic integration, often channel migrants toward real estate investments rather than productive entrepreneurial ventures (Ratten & Pellegrini, 2019).

Therefore, this study investigates the two different profiles of entrepreneurs: opportunity-driven and necessity-driven; their motivations, barriers, and policy implications of Brazilian migrant entrepreneurship, focusing on

how these individuals navigate Portugal's business landscape. This research addresses two questions: 'What motivates Brazilian entrepreneurs in Portugal? And 'how can policies support their success?' Drawing on 58 in-depth interviews and secondary data, following Johnson and Rowlands (2012), the study employs thematic analysis (Gioia et al, 2013). Some migrants also choose Portugal as an entry point into the EU, relocating after acquiring residency rights (Schrooten et al, 2016). While opportunity-driven businesses tend to scale in consulting, tech, and gastronomy, necessity-driven ventures (Fairlie & Fossen, 2020) concentrate in labour-intensive sectors, facing more structural barriers. Despite challenges, Brazilians—numbering over 368,000 (Statista, 2023)—enhance economic diversity, generate jobs, and stimulate urban revitalization.

2. Literature Review

2.1 The Mixed Embeddedness Framework Applied to the Brazilian Migration to Portugal

Migrant entrepreneurship plays a vital role in economic development by generating employment, fostering innovation, and diversifying markets (Kloosterman & Rath, 2010; Ram et al, 2017). Immigrant entrepreneurs leverage distinct skills, networks, and cultural insights to identify niche opportunities and introduce novel products. The mixed embeddedness framework, developed by Kloosterman (2018), offers a comprehensive lens to understand these dynamics by examining how entrepreneurial activity is shaped by the interplay of individual, social, and structural factors. At the micro level, it considers personal resources and motivations; at the meso level, it emphasizes social networks and community support; and at the macro level, it focuses on institutional contexts such as immigration policies and labour market regulations. This framework moves beyond culturalist interpretations by underscoring the interaction between entrepreneurial agency and structural constraints.

Brazilian migration to Portugal reflects shifting economic and political dynamics, facilitated by linguistic and cultural affinities (Esteves et al, 2018). While earlier waves included students and professionals, recent flows comprise both skilled entrepreneurs and low-wage workers (Rath & Swagerman, 2016). Many Brazilians pursue self-employment due to barriers in the formal labour market, yet entrepreneurial outcomes vary based on legal status, financial resources, and access to networks (Solano, 2016).

While some succeed in high-value sectors like technology and gastronomy, others remain confined to low-margin industries such as construction and retail (Lantai et al, 2024). Despite challenges such as bureaucracy, limited credit, and regulatory hurdles (Kloosterman & Rath, 2010), Brazilian entrepreneurs contribute meaningfully to Portugal's economy. Strengthening their long-term viability requires policies that expand credit access, streamline business registration, enhance entrepreneurship training, and foster integration into Portuguese business ecosystems (OECD, 2019; Ram et al, 2017).

2.2 Motivations, Barriers, and Institutional Support for Migrant Entrepreneurship

Research on migrant entrepreneurship highlights a wide range of motivations shaped by personal circumstances, market opportunities, and institutional frameworks (Kloosterman & Rath, 2010). Among Brazilian entrepreneurs in Portugal, motivations often reflect push factors—such as economic instability, violence, and political uncertainty—and pull factors like cultural affinity, favourable business conditions, and access to the EU market. Opportunity-driven migrants tend to leverage Portugal's strategic advantages to pursue scalable ventures, often entering higher-margin sectors such as technology and consulting with prior experience, capital, and strategic intent (Fairlie & Fossen, 2020). In contrast, necessity-driven entrepreneurs typically emerge from more vulnerable conditions and start small businesses using personal savings and informal networks, frequently concentrated in saturated, low-skilled sectors like beauty and construction (Solano, 2016; Rath & Swagerman, 2016). These ventures often face systemic constraints such as bureaucratic red tape, limited credit access, and institutional neglect.

To support this heterogeneous landscape, tailored policies are essential. Necessity-driven entrepreneurs benefit from expanded credit, simplified procedures, and targeted training, while opportunity-driven ventures require innovation incentives and support for scaling (OECD, 2019). Broader institutional barriers—such as restrictive visa processes, high interest rates, and financial illiteracy—continue to hinder business growth (Kloosterman, 2018). Social challenges including language barriers, discrimination, and limited networks further constrain integration (Ram et al, 2017). Targeted interventions like incubators, mentorship, microcredit schemes, and regulatory reform can facilitate formalization and long-term success (Desiderio, 2014). Within this landscape, female migrant entrepreneurs face additional gendered constraints. Studies reveal how women from Latin America and the Middle East navigate intersecting cultural, legal, and economic barriers, balancing tradition

with innovation (Villar, 2019). Intersectional and context-sensitive approaches remain crucial to fully understanding and supporting the entrepreneurial trajectories of migrant women.

3. Methodology

3.1 Data Collection

Using a qualitative research approach, this study draws on 58 in-depth interviews with Brazilian entrepreneurs established in Portugal. Data collection was conducted in person between October 2024 and February 2025. The interview guide included questions related to: (i) the participant's individual migratory trajectory; (ii) their experience in creating and managing their businesses; (iii) the opportunity structures encountered; (iv) the importance of networks and social mechanisms for business survival and success; (v) financial issues; (vi) administrative or legal advisory services; (vii) local partnerships and suppliers; and (viii) logistical and business support issues.

Questions about business size or revenue were avoided, as participants considered them sensitive or linked to vulnerabilities. Each interview lasted approximately one hour and fifteen minutes on average, was fully recorded and transcribed, resulting in a total of 4,125 minutes of audio and approximately 380 pages of transcription. Only one interview was conducted per participant, although the data were triangulated with field notes and the researcher's participant observation.

3.2 Data Analysis

A thematic analysis was conducted using the Gioia methodology (Gioia et al, 2013), which emphasizes inductive theory building while preserving participants' voices. This approach was well-suited to the study's aim of generating theoretical insights grounded in the lived experiences of migrant entrepreneurs. The analysis followed a three-stage process—first-order concepts, second-order themes, and aggregate dimensions—ensuring analytical rigor, transparency, and a strong connection between empirical data and theory (Gehman et al, 2018).

In the first stage, we identified first-order codes by closely examining participants' own words and meanings, avoiding pre-imposed theoretical frames. In the second stage, we distilled these into more abstract second-order themes, interpreting patterns and relationships across the data. This shift enabled a transition from descriptive to conceptual analysis, informed by existing literature. Additionally, interview transcripts were examined considering relevant studies following Johnson and Rowlands' (2012) recommendations, reinforcing the credibility and depth of the theoretical constructs developed.

Finally, we synthesized the second-order themes into aggregate dimensions—higher-level categories that captured the core theoretical insights of the study. The data structure served not only as an analytical tool but also to convey the transparency of the coding process and the logic behind the emergent theoretical model. The interviews were than grouped in two segments based on their profiles and motivations: opportunity-driven and necessity-driven entrepreneurs (see table 1).

4. Findings

4.1 Presentation of Data

According to their profiles and characteristics, most of the entrepreneurs of the sample were framed into opportunity driven as shown in Table 1.

Table 1: Sample of interviewees

Opportunity Driven	Necessity Driven
E1, E3, E4, E5, E6, E7, E8, E10, E11, E13, E14, E15, E16, E17, E18, E20, E23, E24, E26, E27, E28, E30, E31, E32, E33, E34, E35, E36, E37, E40, E41, E42, E43, E44, E45, E46, E47, E48, E49, E50, E52, E53, E55 e E58	E2, E9, E12, E19, E21, E22, E25, E29, E38, E39, E51, E54, E56 e E57

Source: own elaboration

The 58 interviews with Brazilian entrepreneurs in Portugal revealed two predominant profiles, commonly recognized in international literature: opportunity-driven and necessity-driven entrepreneurs. The interviews reveal a dual pattern of entrepreneurial motivation among Brazilian migrants, distinguishing between opportunity-driven and necessity-driven pathways. Opportunity-driven entrepreneurs, comprising the majority, often migrated with clear business plans, financial capital, and professional experience, enabling them to engage in extensive pre-migration planning, conduct market research, and formalize their businesses quickly—often in scalable sectors like technology and consulting. In contrast, necessity-driven entrepreneurs typically transitioned from low-wage jobs, such as caregiving or construction, due to job insecurity or lack of credential recognition. Their ventures emerged gradually, supported by community networks and family labour, and were commonly concentrated in sectors with low entry barriers like personal services and retail. While opportunity-driven entrepreneurs benefited from structured strategies and reduced reliance on external financing, necessity-driven counterparts relied on incremental growth and resourcefulness. Nonetheless, the distinction between these profiles was fluid: some necessity-driven entrepreneurs later expanded and adopted strategic planning, while others initially classified as opportunity-driven faced setbacks that led them to downscale. These findings echo prior research (Rath & Kloosterman, 2000; Baycan-Levent & Nijkamp, 2009), underscoring how varying access to resources, planning, and institutional recognition shapes the entrepreneurial trajectories of migrant populations. This reinforces Kloosterman and Rath's (2010) emphasis on how mixed embeddedness conditions influence business positioning and strategic capacity.

While the categorization of opportunity- and necessity-driven entrepreneurs offers analytical clarity, it becomes more meaningful when grounded in the lived experiences of Brazilian migrants. Opportunity-driven entrepreneurs typically arrived with structured plans, higher education, and prior success in fields like consulting, engineering, and tech, viewing migration as a strategic move toward reinvention or lifestyle improvement. They often brought capital, pursued franchise models, and aligned their ventures with personal values such as sustainability and autonomy. In contrast, necessity-driven entrepreneurs came from precarious conditions—marked by unemployment, informal work, or personal crises—and started businesses out of immediate need, relying heavily on community support and resilience. These ventures, often in sectors like beauty, food, or services, began informally and slowly formalized over time, sometimes evolving into more strategic models.

Despite differing starting points, both groups shared common elements: a strong female presence, varied age ranges, geographic dispersion across cities like Lisbon and Porto, and migration framed as a means of achieving protection, independence, or family stability. Ultimately, all entrepreneurs expressed a shared goal of rebuilding their lives and achieving meaningful livelihoods in Portugal, highlighting the interplay between planning and improvisation, and the central role of perseverance—findings that echo existing literature on migrant entrepreneurship trajectories (Rath & Kloosterman, 2000; Baycan-Levent & Nijkamp, 2009). Table 2 presents the second-order categories associated with each entrepreneurial profile.

Table 2: Second order categories by entrepreneurial motivation

Entrepreneurial Motivation	Second-Order Categories (Thematic Insights)
Opportunity-Driven	• Structured migration plans and strategic intent • Higher education and prior professional success • Business as reinvention, internationalization, or lifestyle choice • Use of accumulated capital and franchise models • Value alignment (e.g., sustainability, autonomy, family well-being) • - Sectors: consulting, education, tech, engineering
Necessity-Driven	• Migration triggered by unemployment, informality, or personal crises • Informal or unplanned business start-up • Reliance on community networks and resilience • Entry into accessible, low-barrier sectors (beauty, food, services) • Gradual formalization for social benefits or stability • - Emergence of strategic thinking over time

Source: own elaboration

4.2 Entrepreneurial Motivations

Preliminary findings suggest that Brazilian entrepreneurs in Portugal are motivated by a combination of opportunity-driven and necessity-driven factors. While some view Portugal as a strategic entry point for European markets, others turn to entrepreneurship due to difficulties securing employment (see Table 3).

Table 3: Opportunity and necessity-driven entrepreneurs

Feature	Opportunity-Driven Entrepreneurs	Necessity-Driven Entrepreneurs	Examples (from Interviews)	Implications
Motivation	Market opportunity, autonomy, lifestyle change	Lack of job opportunities, survival needs	Franchise acquisition, consultancy, tech startups vs. informal salons, food stalls	Requires tailored policy focus based on planning capacity
Pre-migration Planning	Extensive research and strategic foresight	Little to none, reactive approach	Used diaspora networks, legal support vs. trial and error with family help	Opportunity-driven benefit from startup support, necessity-driven need training
Financial Resources	Capital reserves or external investments	Personal savings, family loans	Initial equity vs. bootstrapped ventures	Credit access should differentiate profile needs
Business Type	Consulting, IT, education, niche services	Beauty, cleaning, food delivery, retail	Registered limited company vs. informal micro-business	Sector-specific interventions are key
Challenges	Market adaptation, regulation	Legal status, bureaucracy, informality	Complex tax system vs. delayed regularization	One-size-fits-all policy may fail

Source: own elaboration

Given the notable proportion of female entrepreneurs in the sample, future research could further explore gender-specific motivations and constraints.

4.3 Barriers to Immigrant Entrepreneurship in Portugal

Migrant entrepreneurs in Portugal face a complex array of structural, financial, and social challenges that influence their ability to establish and grow their businesses, regardless of background or motivation (Desiderio, 2014). One of the most significant obstacles is navigating bureaucratic systems, including lengthy registration procedures, visa regulations, and unfamiliar legal frameworks (OECD, 2019; Rath & Kloosterman, 2000). These administrative burdens often delay business operations and contribute to informality, especially when compounded by digital illiteracy or lack of access to legal support (Kloosterman et al., 1999). Financial barriers are equally salient, as many migrant entrepreneurs lack credit history and face high rejection rates from banks, forcing them to rely on personal savings or informal lending networks (Baycan-Levent & Nijkamp, 2009). Even those with initial capital encounter difficulty accessing public funding and investment programs, which are often tailored to local or EU-based applicants (Desiderio, 2014).

Market adaptation poses further difficulties, as entrepreneurs must understand local consumer behaviour, adjust to new competition dynamics, and often reposition their offerings to fit the Portuguese context (Kloosterman & Rath, 2010; Solano, 2016). Many enter oversaturated sectors such as food, cleaning, and beauty, where intense competition and low profit margins hinder sustainability. Others target more competitive but higher-barrier industries like technology or consulting, where success depends on integration into formal business networks and local credibility (Fairlie & Fossen, 2020). However, access to these networks remains limited, as many migrant entrepreneurs struggle with weak social capital, limited professional connections, and, at times, discrimination (Ram et al, 2017). Addressing these intersecting challenges requires targeted policy interventions aimed at simplifying administrative processes, improving financial inclusion, supporting market adaptation, and fostering diverse, inclusive business networks (OECD, 2019; Desiderio, 2014). This aligns with Ram et al. (2017), who stress the structural exclusion of migrants from mainstream entrepreneurial ecosystems.

Enclave-style businesses are ventures embedded within ethnically concentrated communities, often known as ethnic enclaves. They primarily cater to co-ethnic customers by offering culturally specific goods and services—such as traditional foods, clothing, or religious products. These businesses frequently rely on informal ethnic

networks for labour, financing, and supply chains, drawing on family ties or community-based support. Their sustainability is closely linked to the geographic clustering of immigrant populations, as they are typically located in neighbourhoods with a high density of migrants from the same origin.

While enclave-style businesses can offer protective environments for immigrant entrepreneurs—providing easier market entry, linguistic familiarity, and lower competition—they may also limit opportunities for growth and broader market integration. These enterprises often remain confined to niche markets and face challenges in expanding beyond the boundaries of the enclave. Despite these constraints, enclave businesses represent an important strategy of economic survival and cultural preservation for many migrants (Portes & Jensen, 1989).

4.4 Enhancing the Entrepreneurial Ecosystem for Migrant Entrepreneurs

To create a more supportive environment for migrant entrepreneurs, policymakers must address key structural barriers such as complex bureaucracy, limited financial access, and lack of tailored training. Streamlining administrative procedures—especially business registration and visa applications—through digitalization and clearer regulatory frameworks would reduce delays and encourage formalization, fostering entrepreneurship and job creation (OECD, 2019). Financial inclusion is equally critical, as many migrant entrepreneurs lack credit history or collateral. Expanding access to microloans, alternative financing, and migrant-focused investment programs can help bridge this gap, especially through partnerships between government, financial institutions, and impact investors (Desiderio, 2014). Entrepreneurship training is another crucial area: programs focused on business planning, financial literacy, and digital marketing can strengthen migrants' ability to navigate unfamiliar markets. Public-private partnerships and university-led initiatives could serve as effective platforms for such capacity building (Kloosterman & Rath, 2010).

Tailored policy design must also recognize the diversity among migrant entrepreneurs, adapting support to different needs and contexts. High-growth ventures may benefit from mentorship and acceleration programs, while smaller or necessity-driven businesses require microcredit and simplified guidance. Interview evidence underscores the urgency of these measures: many migrants faced long delays due to limited legal information and digital literacy, while others relied on informal advice and struggled to secure formal credit, even when bringing capital from abroad. Training and mentorship proved transformative for market adaptation, especially for those with access to incubators, workshops, and local networks. However, effectiveness depends on regional accessibility and delivery formats—highlighting the need for inclusive, decentralized support models that reach beyond major cities. Ultimately, migrant entrepreneurs' success is shaped not only by their capabilities but also by the host country's institutional openness and investment in inclusive entrepreneurship ecosystems (Rath & Swagerman, 2016).

Table 4 describes the main barriers faced by Brazilian migrant entrepreneurs in Portugal, contrasting how these barriers manifest differently among necessity-driven and opportunity-driven profiles.

Table 4: Comparison of barriers by motivational profile

Barrier Type	Necessity-Driven Entrepreneurs	Opportunity-Driven Entrepreneurs	Observed Impact	Example of quotes extracted from interviews
Financial Constraints	Limited savings, no access to credit	May have capital but face high operational costs	Limits business growth and formalization pace.	"I used family money and had to sell my car in Brazil to get started." (E12)
Regulatory Complexity	Informal businesses, legal status issues	Bureaucratic hurdles, tax complexity	Delays formalization and increases operating risk.	"I spent months trying to regularize the business, but I couldn't open a bank account." (E39)
Market Access	Low-profit sectors, informal networks	High competition, difficulty accessing key industries	Constraints of profitability and business differentiation.	"I had to reformulate my plan because I didn't understand the local market." (E44)
Social Barriers	Language issues, discrimination	Limited access to elite business networks	Limits client base diversity and partnership potential.	"I've never been invited to local business events." (E53)
Business Growth	Dependence on Brazilian community	Need for stronger local partnerships	Uneven growth trajectories across both groups.	"Almost all of my clients are Brazilian; I couldn't break that bubble." (E29)

Source: own elaboration

Drawing on qualitative data from 58 interviews, the table synthesizes key challenges across five dimensions: financial constraints, regulatory complexity, market access, social barriers, and business growth capacity. While both groups experience significant obstacles, the nature and intensity of these challenges vary. Necessity-driven entrepreneurs tend to operate with limited financial resources and lower legal literacy, often navigating informal markets and relying on family support. In contrast, opportunity-driven entrepreneurs are generally more prepared but still struggle with regulatory complexity and difficulties accessing high-value sectors or elite business networks.

5. Conclusion

This study investigates the motivations, challenges, and policy implications of Brazilian migrant entrepreneurship in Portugal, drawing on 55 in-depth interviews to explore how structural conditions and individual trajectories intersect. By distinguishing between opportunity-driven and necessity-driven entrepreneurs, the analysis reveals distinct patterns: while opportunity-driven entrepreneurs often face hurdles related to market adaptation and regulatory complexity, necessity-driven entrepreneurs are more affected by financial constraints and barriers to formalization. Notably, the findings challenge fixed typologies by showing that entrepreneurial motivations and migration pathways are fluid—some necessity-driven entrepreneurs evolve toward growth-oriented strategies, while some opportunity-driven ones confront unanticipated setbacks. These dynamics underscore the need for more flexible and integrative analytical models. As highlighted in Solano's (2016) work on transnational practices, entrepreneurial trajectories often defy static categorizations. Methodologically, the study combines thematic and narrative approaches to examine how bureaucratic, financial, and social constraints coalesce to shape entrepreneurial outcomes and integration pathways.

5.1 Contributions and Policy Implications

This research contributes to the literature by providing a nuanced understanding of Brazilian migrant entrepreneurship in Southern Europe and advancing the application of mixed embeddedness theory to a Lusophone context. The study identifies the differentiated needs of migrant entrepreneurs and offers policy recommendations accordingly. Necessity-driven entrepreneurs require targeted interventions such as simplified business registration, access to microcredit, legal assistance, and foundational training. In contrast, opportunity-driven entrepreneurs benefit more from support mechanisms focused on scaling, internationalization, and venture capital access. Both groups would gain from strengthened integration into local business networks—especially in peripheral regions—and from gender-sensitive policies that support women's entrepreneurial resilience. The findings emphasize that inclusive, differentiated support frameworks are essential for fostering sustainable migrant entrepreneurship.

5.2 Limitations

While the study offers in-depth insights, its qualitative nature and focus on Brazilian entrepreneurs in Portugal limit the generalizability of the findings. The sample, although diverse in terms of age, gender, and geographic distribution, reflects a single national group within a specific host-country context. As such, the conclusions may not apply to other migrant populations or national settings. Furthermore, the reliance on self-reported narratives introduces subjectivity, which, while valuable for understanding lived experiences, may overlook structural dynamics not visible to participants. These limitations point to the need for complementary research using comparative, quantitative, or mixed methods approaches.

5.3 Future Research Directions

Future studies should examine cross-cutting themes that emerged across different entrepreneurial profiles, particularly the strong female presence and diversity in age and life-course stages. Further investigation into how motivations such as protection, autonomy, and family care shape entrepreneurial strategies could enhance understanding of gendered and familial dynamics in migrant entrepreneurship. The regional dispersion of businesses—spanning Lisbon, Porto, Leiria, and other areas—warrants research on how local institutional and economic contexts mediate opportunity structures. Additionally, exploring long-term business trajectories—including transnational expansion, return migration, or intergenerational succession—can illuminate the evolving nature of migrant entrepreneurship. The interplay between structured planning and improvisation suggests promising avenues for studying hybrid strategic behaviours under uncertainty. Future research could

explore digital entrepreneurship and compare groups (e.g., African, Asian migrants) or longitudinal studies to assess business sustainability across different contexts and temporal scales.

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Ethics Declaration

This research involved human participants through interviews and surveys. Ethical clearance was obtained from the appropriate institutional ethics committee prior to data collection. The study was reviewed and approved by the Ethics Committee of Universidade do Grande Rio [UNIGRANRIO], under protocol number CAAE-84607524.1.0000.5283, granted in November/2024.

Participants were informed of the study's objectives, and informed consent was obtained from all individuals involved. Data was anonymized to ensure participant confidentiality and privacy in accordance with data protection regulations.

Use of AI Tools

Artificial Intelligence (AI) tools were used during the preparation of this paper. Specifically, AI-assisted translation tools were employed to support the translation and refinement of sections originally drafted in Portuguese. The final content was reviewed and edited by the authors to ensure accuracy, coherence, and adherence to academic standards. No AI tools were used to generate original research content, analyse data, or draw conclusions.

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Optimizing Startup Team Composition: A Generative AI and Genetic Algorithm–Based Approach

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Abstract: Founding team composition is widely acknowledged as a key determinant of startup ventures success. Entrepreneurship scholars have examined founding teams' characteristics through various perspectives, including human and social capital, psychological traits, personality, and diversity. Despite the recognized importance of team composition, traditional team formation methods often rely on convenience or heuristic-based combination. These approaches frequently overlook the systematic alignment of critical attributes such as complementary skill sets, personality compatibility, and shared motivations, leading to suboptimal outcomes and ultimately impacting team dynamics and performance. Given the transformative impact of generative Artificial Intelligence (AI) across multiple entrepreneurship domains, we investigate how Large Language Models (LLMs) can enhance the process of founding team formation by making the most of individual profiles. By employing advanced prompt engineering techniques, we properly instructed an LLM to develop a genetic algorithm to iteratively optimize team formation by evaluating and refining groups of three based on multiple criteria. The designed algorithm considers multiple sets of team configurations and efficiently converges on team assignments by applying selection, crossover, and mutation over subsequent generations to maximize demographic variety, hard and soft skills variety, personal value and motivation similarity and personality compatibility (based on the Big Five model). To facilitate reproducibility, we provide detailed prompt engineering strategies for implementation. To validate our method, we conduct an empirical study within a higher education entrepreneurship course where students are required to work in teams. We evaluated each team composition across seven metrics and assigned each team an overall score. Results suggests the effectiveness of our AI-assisted team formation approach. Our study addresses the growing interest in integrating generative AI into entrepreneurship research, offering insights to multiple stakeholders. While we tested our approach in the educational context, its applicability extends also to practitioners, including aspiring entrepreneurs searching for co-founders, startup studios forming founding teams, and organizations enhancing recruitment strategies.

Keywords: Startup, Team, Generative Artificial Intelligence, Large Language Model, Chatgpt, Genetic Algorithm

1. Introduction

When investigating the underlying reasons of startup failures, a flawed founding team frequently emerges as a key contributing factor (Wasserman, 2012). Nevertheless, many entrepreneurs still form teams primarily based on convenience rather than through a systematic combination of individuals' critical attributes (Ruef, Aldrich and Carter, 2003). Scholars has long debated whether team composition holds greater significance than other dimensions of nascent entrepreneurial ventures—such as the product or service, market potential, or financial structure—often considering these attributes as distinct, and framing the discussion through the so-called "jockey versus horse" controversy (MacMillan, Siegel and Narasimha, 1985). However, as Carpentier and Suret (2015: 819) state, "only experienced entrepreneurs are able to present sound projects," which suggests a relationship between entrepreneurial experience and the overall quality of the venture. While seasoned entrepreneurs may cultivate suitable co-founder selection ability, novice founders may lack this experience, making the team formation process particularly challenging. Nevertheless, some principles can inform the formation of a solid founding team (Arendt, 2024; Jin et al., 2017).

The small size of founding teams—typically comprising two to four individuals—makes the integration of non-overlapping expertise particularly important. When each co-founder assumes exclusive ownership over a distinct functional area without redundancy—such as product development, design, or sales—the team benefits from a clear division of responsibilities resulting in a broader spectrum of expertise and increased efficiency in decision making, learning curves, and coordination (Roberts, Negro and Swaminathan, 2013; Xiao et al., 2020). At the same time, to deal with the high level of uncertainty in early-stage ventures, co-founders need to share a set of personal motivations—whether related to social impact, lifestyle balance, or financial returns. Such alignment facilitates collective resilience and decreases the likelihood of conflict arising from divergent understandings of success (Murnieks, Klotz and Shepherd, 2020; Shane, Locke and Collins, 2003). Moreover, a common set of core personal values—such as integrity, helpfulness, humbleness—enables co-founders to approach complex dilemmas in a consistent way and contributes to the development of the emerging organizational culture (O'Neil, Ucbasaran and York, 2022). Given that building a new venture demands extended commitment and resilience, the compatibility of team members' personalities also plays a key role in both team

effectiveness and long-term cohesion. When individuals exhibit aligned personality traits—such as conscientiousness, emotional stability, and openness to experience—they tend to engage in more effective communication, manage conflicts assertively, and maintain morale during inevitable setbacks (Freiberg and Matz, 2023; McCarthy et al., 2023). Finally, demographic variety—in terms of gender, ethnicity, age, or socioeconomic background—introduces a wider spectrum of life experiences, cultural knowledge, and social networks thereby expanding the team's cognitive capacity. However, especially in creative or innovative industries, diversity is positively related to creativity only within an inclusive environment, suggesting that without genuine integration of diverse perspectives into collaborative decision-making, diversity alone may not yield performance gains (Vedres and Vásárhelyi, 2023)

Despite the availability of such guiding principles, aspiring entrepreneurs frequently tend to select business partners based on perceived personal similarity (Kaiser and Müller, 2015) thereby limiting their selection to individuals within their immediate social circle. This approach occurs not only in the real-world entrepreneurial context but also in the educational environments. In the classroom, for instance, instructors who design group-based assignments often observe students choosing to collaborate with friends or people they already know (Gompers, Huang and Wang, 2017). Although prior familiarity may intend interpersonal compatibility, it does not necessarily ensure that the resulting teams possess the optimal combination of hard and soft skills, values and motivation necessary for success.

To enhance the team formation process, we offer a novel approach based on generative Artificial Intelligence (AI) and genetic algorithms. As general-purpose technologies, Large Language Models (LLMs) are showing increasing applications across multiple entrepreneurial domains, both in research (Ferrati, Kim and Muffatto, 2024) and practice (Fossen, McLemore and Sorgner, 2024). Most recent LLMs—such as ChatGPT o3 and o4-mini-high—incorporate reasoning-based modes that provide users with the ability to address challenging problems through a structured, step-by-step process (Yao et al., 2023; Wei et al., 2022). These models not only elaborate problem-solving strategies but also feature the capacity to autonomously generate and execute programming code, allowing both the development and direct implementation of solutions (Hou and Ji, 2025). As a response to the academic community's calls to explore how generative AI can advance entrepreneurship in both research and practice (Kusetogullari et al., 2025), in this study we demonstrate the potential of LLMs in the creation of founding teams.

To encourage experimentation with our approach, we offer two main contributions. First, we introduce a reproducible LLM-driven genetic algorithm for team formation, accompanied by comprehensive implementation guidelines and the tailored prompts we designed for use by educators and practitioners. Second, we empirically test the algorithm's effectiveness through an experimental study in the educational context, evaluating the results using key indicators such as variety, similarity and compatibility.

2. Methodology

To evaluate the effectiveness of our approach, we conducted an experiment in an educational environment, specifically within a master's-level entrepreneurship course where students worked in teams to develop innovative entrepreneurial projects. The student population, drawn from various courses of study in engineering (e.g., computer science engineering, electronic engineering, biomedical engineering), provided an ideal case for application. The experiment was conducted in three main phases: (1) profiling participants through an online form, (2) designing and implementing the team formation algorithm using generative AI, and (3) evaluating the method performance. Starting with the self-profiling of single individuals, our method automatically forms balanced teams based on well-established criteria in academic research.

2.1 Data Gathering

The first step in the team formation process requires each individual to create a self-profile. A total of 45 students took part in the study, all of whom provided informed consent for their anonymized data to be used for research purposes. Each participant was asked to fill a specially designed form to describe themselves according to seven key attributes: two demographic factors (gender and nationality), two related to their capabilities (hard skills and soft skills), and three concerning their psychographic characteristics (personal values, motivations and personality traits).

Our sample consists of 64 percent male and 36 percent female students, revealing a significant gender imbalance. While most of the participants are from Italy (60 percent), the remaining 40 percent come from a

variety of European and non-European countries, giving the study a valuable extent of international and intercultural diversity. To map a comprehensive insight into individual capabilities, we asked each participant to self-report five hard skills and five soft skills. Participants declared 156 unique hard skills, reflecting a wide range of technical and discipline-specific expertise across multiple domains. Similarly, they reported 116 distinct soft skills, covering a broad spectrum of interpersonal, cognitive, and emotional abilities. To capture the psychological drivers that influence individual behaviour and decision-making, we asked participants to list five core personal values and five primary sources of motivation, alongside completing a personality assessment. In total, we collected 91 personal values, representing a large variety of beliefs and priorities, and 135 unique personal motivations, corresponding to different drivers that inform participants' actions. For personality profiling, participants took an online test based on the Big Five model (McCrae and Costa, 1987) and reported their score for each of the five traits—openness, conscientiousness, extraversion, agreeableness, and neuroticism.

Table 1 presents an example of an individual profile format submitted by participants. To ensure consistency and facilitate the subsequent algorithmic processing, we instructed participants to enter their hard skills, soft skills, personal values, and personal motivations into the form using the specific syntax ['item 1', 'item 2', 'item 3', 'item 4', 'item 5'].

Table 1: Sample of an individual's self-profiling entry

Attribute	Example
Gender	Female
Nationality	Italian
Hard skills	['deep learning', 'python', 'full stack development', 'project management', 'user experience']
Soft skills	['problem-solving', 'critical thinking', 'emotional intelligence', 'communication skills', 'empathy']
Personal values	['integrity', 'kindness', 'curiosity', 'helpfulness', 'humbleness']
Personal motivations	['joy', 'growth', 'impact', 'challenges', 'financial reward']
Personality trait (Big Five)	Openness: 90, Conscientiousness: 72, Extraversion: 91, Agreeableness: 97, Neuroticism: 60

2.2 Designing and Generating the Algorithm

To build effective teams based on individual profiles, we structured the logic of our team-formation algorithm around three interdependent phases as outlined in Figure 1. First, we systematically classified the information provided by participants. Second, we defined and assigned archetypes based on these classifications. Third, we generated and applied a genetic algorithm to optimize team composition. For implementation, we employed ChatGPT using the o4-mini-high model, an advanced reasoning model particularly well-suited for programming-related tasks. To ensure the reproducibility of our process, we provide a detailed description of each phase, including the specific prompt engineering strategies we designed.

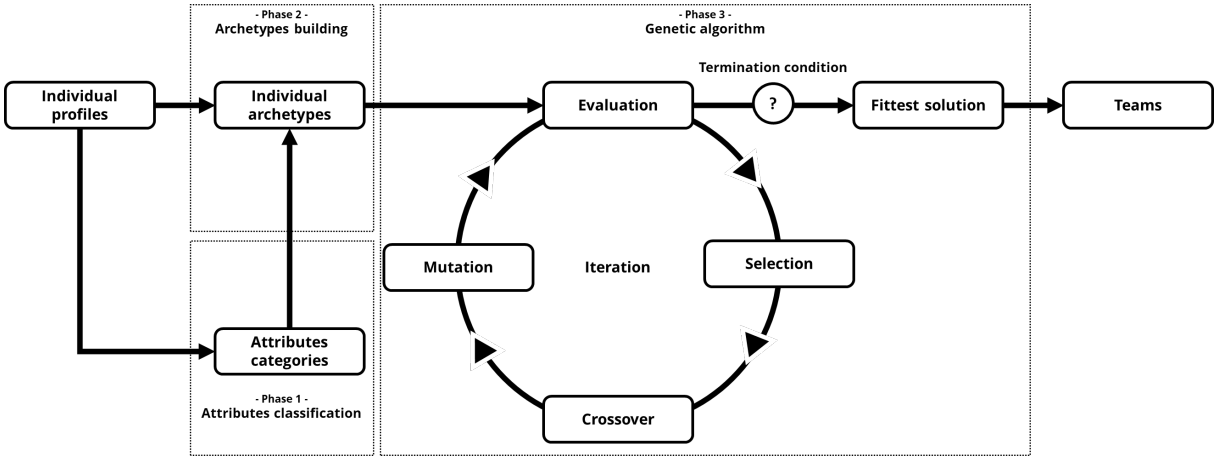


Figure 1: Operating logic of the team formation algorithm

2.2.2 Classifying Attributes

When collecting the data, we employed an open-ended format to gather detailed and authentic individuals' information, allowing participants to freely describe their profiles. This design intentionally produced considerable variability in responses. To systematically model each individual's key features, our algorithm first classifies these self-reported items into coherent thematic categories aligned with each variable. As shown in Table 2 this classification process was carried out by prompting ChatGPT according to the "role, context, task and instructions" prompt formula (Ferrati, Kim and Muffatto, 2024). We then double checked that each item was uniquely assigned to a single category to avoid duplication or omission.

At the end of this phase, 156 hard skills were classified into 22 categories, 116 soft skills into 8, 91 personal values into 9, and 135 personal motivations into 13. Figure 2 shows the top five categories of hard skills, soft skills, personal values, and personal motivations, ranked by the number of items in each.

Table 2: Prompt used to classify hard skills (to be adapted in the case of hard and soft skills, values and motivations)

Role: You are an expert data analyst specializing in hard skill taxonomy and classification.

Context: You are provided with multiple lists containing various hard skills across different domains.

Task: Analyse all the items in the provided skill lists and categorize them into clear, meaningful main categories.

Instructions:

- Group together skills that are closely related in meaning and domain.
- Each skill must belong to one and only one category.
- Do not use a "Miscellaneous" or "Other" category.
- Ensure the categorization is highly precise and domain-specific.
- Present the final output in JSON format, where each main category is a key and its associated skills are in an array.

Here are the lists:

[paste the lists here]

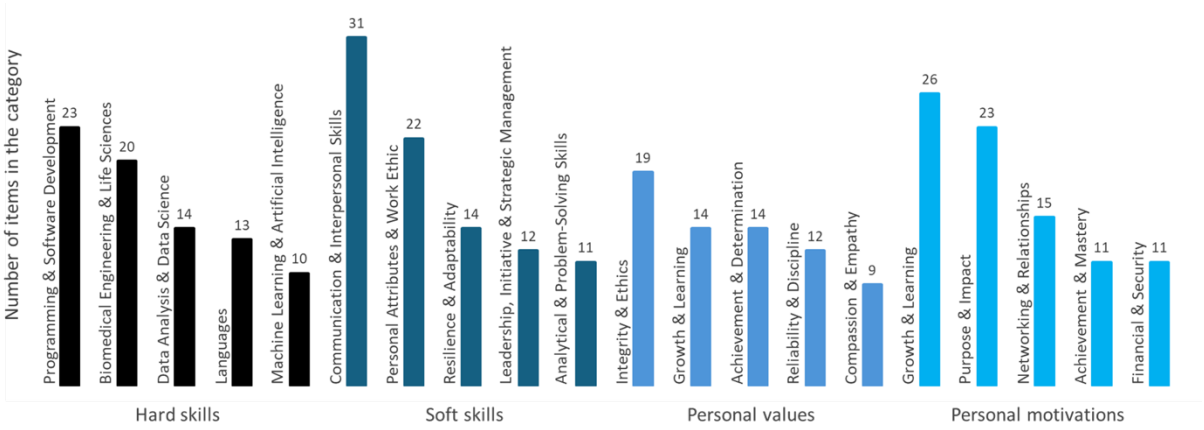


Figure 2: Top five categories of hard skills, soft skills, personal values, and personal motivations by number of items

2.2.3 Assigning Individual Archetypes

After mapping each self-reported items to its corresponding category, we employed ChatGPT to design and implement a strategy that assigns each participant a single representative value for each of the four dimensions: hard skill, soft skill, personal value, and motivation. By analyzing each individual's five submissions per dimension and selecting the most representative category, the algorithm transformed each dimension into a single archetype, significantly reducing profile complexity and improving computational efficiency in the subsequent team formation process. Table 3 shows the prompt we designed to execute this operation.

The algorithm generated by ChatGPT determines a primary category by applying a majority-vote mechanism. For example, in the case of an individual whose hard skills include ['Deep Learning', 'Computer Vision', 'Math', 'Programming', 'Photography']—then categorized as ['Machine Learning & Artificial Intelligence', 'Machine Learning & Artificial Intelligence', 'Mathematics & Logic', 'Programming & Software Development', 'Design & Creative']—the algorithm assigned 'Machine Learning & Artificial Intelligence' as the hard-skill archetype since it appears most frequently.

Table 3: Prompt used to assign archetypes to variables

Role: You are an expert data analyst with experience in structured data transformation.
Context: You are working with a dataset of entrepreneur profiles, which includes the following columns: Hard skills, Soft skills, Personal values, and Personal motivations. Additionally, you have four separate JSON files, each mapping items from one of these columns to their corresponding categories.
Task: Enrich the dataset by categorizing profile attributes using the provided mappings and organizing the results for clarity and transparency.
Instructions:

- For each of the four columns, create a new column named categorized_[column_name] that assigns the most relevant category for each individual, based on the items in their list.
- Use a smart categorization strategy (e.g., based on frequency, priority, or semantic relevance) to determine the most appropriate single category per column when multiple items are listed.
- For transparency, add five intermediate columns per original column (e.g., hard_skill_cat_1, hard_skill_cat_2, ..., hard_skill_cat_5) to show the individual category assigned to each listed item.
- If a person has fewer than five items in a column, leave the remaining intermediate columns blank.
- Preserve all existing data and ensure the final output is clean, consistent, and well-organized.
- Once complete, return the updated dataset and provide it in Excel format (.xlsx) for download.

2.2.4 Implementing the Genetic Algorithm

After assigning archetypes to each participant's hard skills, soft skills, values, and motivations, we generated and implemented the team assignment algorithm using prompt-based techniques. Team formation can be approached algorithmically through several strategies, including random allocation, stratified balancing across multiple dimensions, or by applying specific constraints. Given the complexity of this optimization problem, we employed a genetic algorithm (GA) approach. Table 4 presents the prompt we designed to generate and execute the GA for team formation. GAs are inspired by the principles of evolutionary biology, where individuals with higher fitness are more likely to contribute to the next generation. The code generated by ChatGPT reveals the implementation strategy it applied.

Using GAs' own terminology, in our case the population is a set of fifty candidate solutions per generation. Each member of this population is an individual, and represents a complete ordering of all forty-five participants, which implicitly defines fifteen teams of three. The genetic information carried by an individual refers to a sequence of forty-five integer identifiers, each corresponding to a distinct co-founder profile. Reproduction and genetic recombination are performed by manipulating these identifier sequences.

A fitness function evaluates each individual based on seven criteria and assign them a fitness score, as outlined in Table 5. For gender, nationality, hard skills and soft skills, the algorithm aims to maximize variety; for values and motivations, the objective is to maximize similarity; for personality the goal is to maximize compatibility. Hard skills, soft skills, values and motivations are operationalized through the archetypes assigned in the prior phase. Personality traits, measured through Big Five scores, are treated as points in a five-dimensional space. To evaluate personality similarity, the algorithm computes the Euclidean distance between personality vectors and applies the transformation "1 - (average distance / maximum distance)", where "maximum distance" is the largest difference in personality that could exist between two participants. This strategy favours minimal divergence and maximizes the similarity between personalities.

To simulate evolutionary processes, GAs employ three core operators–selection, crossover, and mutation. Selection uses a tournament strategy: three individuals are randomly sampled from the current population, their fitness scores are computed and compared, and the fittest is selected as a parent to propagate its genetic information. Repeating this process fifty times yields the parent pool for the next generation. By mimicking reproduction, crossover combines genetic material from two of these parents to generate offspring by copying a segment from parent A's forty-five-element sequence and filling in the remaining positions in the child with the order-preserved elements from parent B. This order-preserving recombination enables the inheritance of partial team structures from one parent while ensuring genetic mixing by integrating elements of the other. Finally, mutation is introduced by randomly swapping two positions in the offspring's sequence with a 20% probability, maintaining genetic diversity within the population and preventing from converging too quickly on suboptimal solutions

The algorithm repeats the evolutionary cycle—evaluation, selection, crossover, and mutation—for one hundred generations, then terminates the process and select the highest-fitness individual encountered throughout the run as the optimal assignment of the forty-five participants into fifteen teams.

Table 4: Prompt used to generate e genetic algorithm for team formation

Role: You are an expert in genetic algorithms and entrepreneurial team composition and dynamics.

Context: You are provided with a dataset containing detailed profiles of startup founders. The objective is to strategically form founding teams of 3 individuals each, based on factors proven in academic literature to influence team effectiveness in entrepreneurship.

Task: Design and execute a sophisticated genetic algorithm to optimally form 15 teams of 3 founders each, maximizing and balancing key team dynamics.

Instructions:

- Implement a full genetic algorithm pipeline including all essential phases: initialization, evaluation, selection, crossover, mutation, and convergence criteria.
- Optimize the following dimensions for each team: gender variety, nationality variety, hard skill variety, soft skill variety, value similarity, motivation similarity, personality compatibility (based on the Big Five personality traits).
- Ensure that your scoring and fitness functions reflect insights from academic literature on startup team effectiveness, especially regarding how to balance variety, similarity and compatibility.
- Once optimal teams are formed, append a new column to the dataset called assigned_team, indicating the team number (1–15) for each founder.
- Preserve all original data and return the updated dataset in Excel format (.xlsx) for download.

Table 5: Fitness Function applied by the genetic algorithm

Criterion	Score definition	Objective
Gender variety	1.0 if all 3 are different, 0.67 if 2, 0.33 if same gender	Higher: more diverse
Nationality variety	1.0 if all 3 are different, 0.67 if 2, 0.33 if same nationality	Higher: more diverse
Hard Skills variety	1.0 if all 3 are different, 0.67 if 2, 0.33 if same hard skills	Higher: more diverse
Soft Skills variety	1.0 if all 3 are different, 0.67 if 2, 0.33 if same soft skills	Higher: more diverse
Values similarity	Highest frequency of a shared value / 3	Higher: more similar
Motivations similarity	Highest frequency of a shared motivation / 3	Higher: more similar
Personality compatibility	1 - (average pairwise Euclidean distance between personalities / max distance)	Higher: more compatible

3. Results

To assess the effectiveness of our algorithmic approach we assessed the quality of each team using established diversity metrics (Harrison and Klein, 2007). Specifically, for each team, we calculated three distinct measures. First, we calculated Blau's index to assess variety in categorical variables such as gender, nationality, hard skills and soft skills. Second, for personal values and motivations, we employed the complement of Blau's index (1-Blau's index) to capture similarity. Third, to evaluate personality compatibility, we applied the formula [1 - (average pairwise Euclidean distance between personalities / max distance)], which measures the extent to which personality profiles within a team are aligned.

Table 6 reports the metric values for each team, alongside the theoretical minimum and maximum values derived from the properties of each indicator. To facilitate cross-team interpretation and indicators' comparison, we then normalized all indicators on a uniform scale from 0 to 1, as shown in Figure 3. When we examine the normalized values, we observe that the algorithm prioritized maximizing the variety of both hard skills (mean = 0.93; sd = 0.14) and soft skills (mean = 0.96; sd = 0.12) with perfect variety in 80% and 87% of cases, respectively. Similarity in personal values (mean = 0.60; sd = 0.34) and motivations (mean = 0.53; sd = 0.41) reaches the maximum level in 40% of the teams, while in three teams, the algorithm fails to ensure any shared motivation among members. Teams 3 and 7 are particularly noteworthy, as they exhibit perfect alignment in personal values despite showing zero similarity in motivations. This contrast illustrates how the GA may prioritize shared foundational beliefs over alignment in individual drivers when balancing criteria. Personality compatibility is relatively consistent (mean = 0.73; sd = 0.05) suggesting that the algorithm effectively aligned interpersonal dispositions. Considering demographic indicators, variety in gender (mean = 0.64; sd = 0.20) and nationality (mean = 0.78; sd = 0.16) appear limited in some teams due to demographic imbalances in the sample. In cases of low demographic variety, the algorithm still compensated by focusing on maximizing variety in skill domains and reinforcing similarity in personal values and motivations. These results reflect the trade-offs of founding team's composition. By integrating a multi-objective fitness function, our algorithm successfully addressed these tensions, producing practically balanced team configurations.

Table 6: Team metrics evaluation.

(a) Blau's index, (b) 1 – Blau's index, (c) 1 – (Average pairwise Euclidean distance/D_max)

	Gender variety	**Nationality variety**	**Hard Skill variety**	**Soft Skill variety**	**Values similarity**	**Motivations similarity**	**Personality Compatibility**
Metric	*(a)*	*(a)*	*(a)*	*(a)*	*(b)*	*(b)*	*(c)*
Effective K	*min(2,3)=2*	*min(12,3)=3*	*min(13,3)=3*	*min(7,3)=3*	*min(7,3)=3*	*min(8,3)=3*	*–*
Min	*0.000*	*0.000*	*0.000*	*0.000*	*0.333*	*0.333*	*0.000*
Max	*0.500*	*0.667*	*0.667*	*0.667*	*1.000*	*1.000*	*1.000*
Team 1	0.444	0.667	0.667	0.667	1.000	1.000	0.722
Team 2	0.444	0.444	0.667	0.444	0.556	0.556	0.729
Team 3	0.444	0.667	0.667	0.667	1.000	0.333	0.738
Team 4	0.444	0.444	0.667	0.667	1.000	0.556	0.733
Team 5	0.667	0.444	0.667	0.667	0.556	1.000	0.756
Team 6	0.444	0.444	0.444	0.667	0.556	1.000	0.753
Team 7	0.444	0.444	0.667	0.667	1.000	0.333	0.737
Team 8	0.444	0.667	0.444	0.667	0.556	0.556	0.689
Team 9	0.000	0.444	0.444	0.667	0.556	1.000	0.642
Team 10	0.444	0.444	0.667	0.667	0.556	1.000	0.809
Team 11	0.444	0.667	0.667	0.444	0.556	1.000	0.757
Team 12	0.444	0.444	0.667	0.667	0.556	0.333	0.619
Team 13	0.444	0.667	0.667	0.667	1.000	0.556	0.734
Team 14	0.444	0.444	0.667	0.667	1.000	0.556	0.662
Team 15	0.444	0.444	0.667	0.667	0.556	0.556	0.799

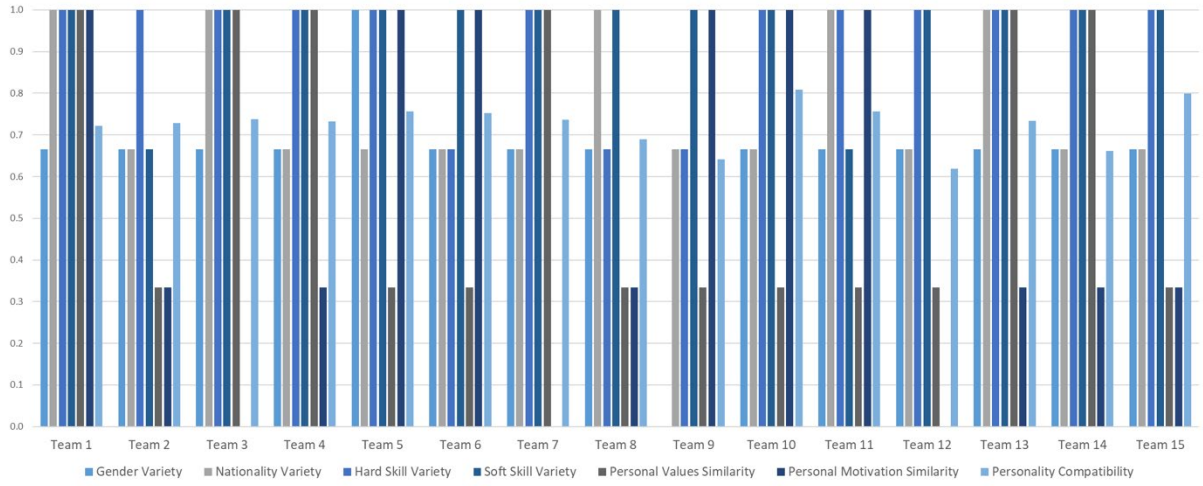


Figure 3: Team metrics evaluation, normalized to [0,1]

While the analysis of individual indicators allows for a disaggregated assessment of the algorithm's performance across distinct dimensions, evaluating the overall quality of each team requires a single, representative composite score. To this end, we employed the Weighted Root Mean Square (Weighted-RMS) Composite. This method involves squaring each metric—thereby amplifying the influence of larger deviations, both high and low—applying a weight to each squared value based on its relative importance, averaging these weighted squares by dividing by the sum of the weights, and finally taking the square root to return the score to the original metric scale. In our implementation, we distributed the weights to ensure a total contribution of 100%. Specifically, we assigned 25% each to hard-skill and soft-skill variety, 15% each to values and motivations homogeneity, 10% to personality compatibility, and 5% each to gender and nationality variety. Although this weighting scheme reflects our evaluation criteria, it can be adjusted based on alternative assessment frameworks.

As illustrated in Figure 4 the resulting Weighted-RMS composite scores for the fifteen teams range from 0.57 to 0.78 on a scale from 0 to 1. The median composite score is 0.68 (mean 0.67; sd = 0.06), indicating overall solid performance. In addition to the overall score, we visualize the weighted specific contribution of each team characteristic, highlighting how the mix of key elements leads to a balanced team configuration. To further evaluate the relative contribution of each individual factor to the overall score, Figure 5 expresses these contributions in percentage terms, thereby facilitating the identification of the most and least influential attributes associated with each team. Given the weights we assigned, we observe that, on average, the diversity of hard skills (mean 0.22; sd = 0.06) and soft skills (mean 0.23; sd = 0.06) exerts the strongest influence on the overall score. This is followed by the similarity of personal values (mean 0.19; sd = 0.10) and motivations (mean 0.18; sd = 0.12), then by personality compatibility (mean 0.12; sd = 0.02), with the least impact coming from diversity in nationality (mean 0.03; sd = 0.01) and gender (mean 0.02; sd = 0.01). However, when analysing the different teams individually, we note that their strengths can differ from the average trend. For example, the score of the best performing team (Team 1) is equally driven by the variety of hard and soft skills, each

contributing 18 percent to the total score, but most significantly by the similarity of personal values and motivations, which together account for almost 50 percent. This case highlights that strong teams can emerge through synergistic mechanisms that emphasize different dimensions of team composition.

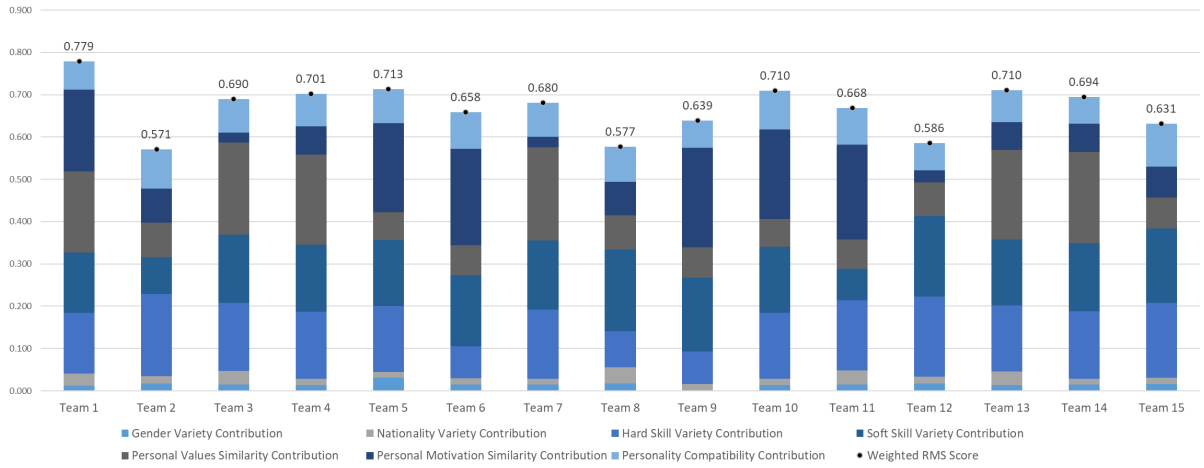


Figure 4: Weighted RMS Score, highlighting the weighted contribution of each attribute

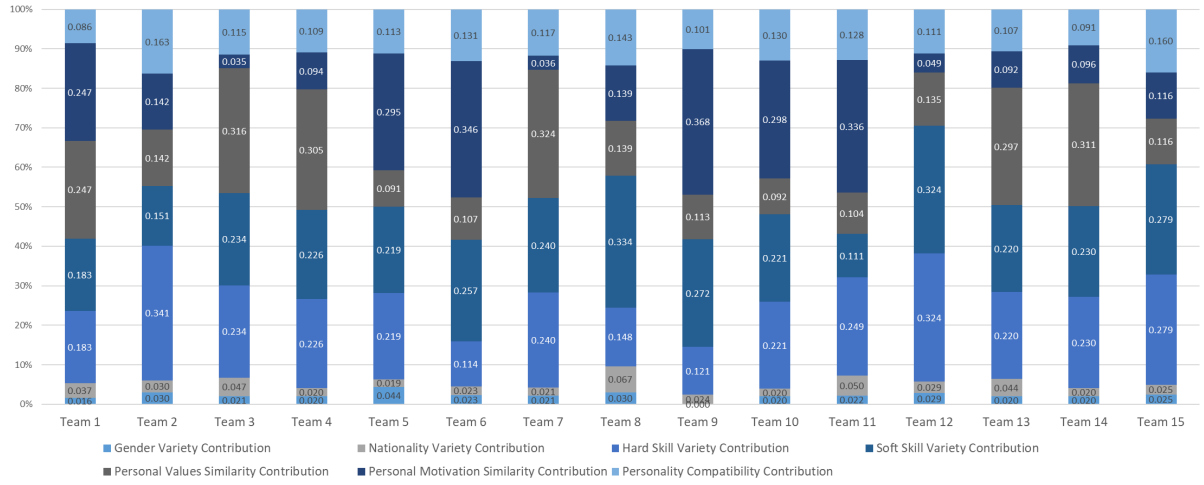


Figure 5: Weighted RMS Score, highlighting the weighted contribution of each attribute as a percentage of the score

4. Discussion and Conclusion

In this study we proposed a novel, replicable approach to entrepreneurial team formation that combines generative AI and genetic algorithms. Although prior research has acknowledged the importance of team composition, it has rarely offered systematic methods for building optimal founding teams. This work aims at contributing to filling this operational gap by demonstrating how algorithmic team formation can optimize key team characteristics simultaneously.

While we experimented with our approach within a higher education entrepreneurship course, it can also be transferred outside of the educational context. For aspiring entrepreneurs and startup studio managers, our findings indicate that generative AI can facilitate founder matching by efficiently analysing individual profiles and forming well-balanced co-founder teams. Similarly, human resource professionals may adopt this approach to enhance recruitment processes and optimize team composition within corporate settings. Moreover, while implementing the genetic algorithm, weighting parameters and selection criteria can be adjusted to meet specific pedagogical or professional objectives—for example, emphasizing creative heterogeneity in innovation-focused curricula or fostering value alignment in social impact projects.

Although being effective, our methodology also presents some limitations that offer opportunities for future development. For example, since we assessed the quality of the teams at the configuration stage rather than throughout the projects' lifecycles, future research should conduct controlled experiments to test whether AI-generated teams outperform teams formed organically by participants. Second, although our fitness function relied on a set of criteria informed by the literature, additional dimensions could be explored, as well as the influence of different weightings on team formation and performance. Third, since we relied on self-reported data, potential biases could have been introduced. To improve accuracy and mitigate social desirability effects, third-party assessments, peer evaluations, or behavioural data could be incorporated.

This work contributes to the ongoing discourse on entrepreneurial team formation by offering an actionable and customizable framework for building high-potential teams in both educational and professional environments.

Ethics Declaration

Given that the study relies on participants' self-profiling data, each individual provided informed consent for the use of their anonymized information for research purposes.

Declaration of Generative AI Usage

After completing the initial draft, the authors employed ChatGPT-4o and -o4-mini-high to refine the clarity and to implement the team formation algorithm as stated in the manuscript. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for its contents.

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Corporate Venture Governance: Key Success Factors and Challenges for Entrepreneurial Autonomy

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Abstract: This study investigates key success factors and challenges in governing corporate venture (CV) initiatives for digital innovation, drawing on in-depth interviews with 40 practitioners from established firms in the German-speaking DACH region. As digital transformation accelerates, corporations increasingly turn to CV as a strategic tool to foster business model innovation and maintain competitiveness. However, effectively balancing entrepreneurial autonomy with integration into the parent organization presents persistent governance challenges. This research organizes its qualitative analysis around three interconnected dimensions defined by previous research: (1) Structures, (2) operations and processes, and (3) relational mechanisms. The study adopts a four-phase methodological approach, including developing and pretesting a semi-structured interview protocol, followed by qualitative content analysis. The sample encompasses a diverse range of industries and CV models, ensuring broad relevance of the findings. The results emphasize management support as a crucial success factor in governance. Executive sponsorship legitimizes CV initiatives, secures resources, and aids corporate navigation. Governance models must balance integration and autonomy while ensuring resource access. Operational barriers include misaligned incentives, resource allocation issues, and bureaucratic inertia. Middle management resistance, budget constraints, and competing priorities hinder CV initiatives. A paradox exists: efficient corporate processes conflict with the exploratory nature of CVs. Successful CVs address these tensions through selective process decoupling and dedicated resources, especially in IT and sales. Relational mechanisms like strong networks, cultural compatibility, and interdisciplinary teams are vital for effective CV governance (CVG). Integrating experienced corporate staff with external hires enhances knowledge transfer and reduces alienation. We provide guidelines for practitioners, emphasizing the need to tailor governance to specific innovation objectives. Recommendations include formalizing executive sponsorship, designing incentive structures, and cultivating cross-boundary networks. The research offers insights that extend existing frameworks and inform academic understanding and managerial practice. Findings underscore the importance of dynamic, context-sensitive governance for leveraging CV as a driver of digital innovation.

Keywords. Corporate Entrepreneurship, Corporate Venturing, Governance, Autonomy, Corporate Startup

1. Introduction

In an era of rapid digital transformation and disruptive business model innovation, established corporations are increasingly compelled to engage in corporate venturing (CV) as a strategic means to sustain competitiveness and foster growth (Chesbrough, 2007). As digital innovation reshapes established industries, the imperative for corporations to adopt agile, entrepreneurial practices becomes even more critical. CV offers a pathway to transcend these structural limitations by creating dedicated entities or programs designed to operate with the dynamism and flexibility of start-ups while leveraging corporate resources to gain a competitive advantage (Urbaniec and Zur, 2021).

However, the successful design and implementation of CV initiatives is challenging, particularly in balancing the need for autonomy with the imperative to maintain a productive relationship with the core corporate structure. On one hand, autonomy is essential to foster an environment enabling exploration, rapid decision-making, and the cultivation of innovative ideas. On the other hand, a close relationship with the parent company is critical to ensure that the outcomes of CVs can be effectively leveraged to secure a competitive advantage (Johnson, 2012). This “tug-of-war” between granting autonomy and establishing the necessary corporate ties presents significant governance challenges (Garidis, Rossmann and Murray, 2024).

While other studies have examined success factors of executing specific CV models (Guardiet, Oreschenko and Wawers, 2022), this study seeks to deepen our understanding of the key success factors and challenges in governing CV autonomy (CVA). Drawing on in-depth interviews with 40 practitioners in the German-speaking DACH region (Germany, Austria and Switzerland) who are directly involved in the design and implementation of CV initiatives, the research addresses the following questions:

RQ1: What are the critical success factors of successful governing CVA?

RQ2: What are the main challenges governing CVA?

RQ3: Which implications can be derived for corporate venturing management?

By systematically examining issues related to corporate entrepreneurship, this study contributes to both research and managerial practice. It offers insights into how established corporations can better navigate the complexities of integrating entrepreneurial ventures within their organizational frameworks. Additionally, it highlights the challenges of securing a competitive advantage from corporate resources while maintaining the necessary autonomy for start-ups. The study emphasizes that tailored governance structures can mitigate inherent conflicts between autonomy and corporate control. Ultimately, the findings aim to inform strategies that enhance the effectiveness of CV initiatives, thereby driving sustainable digital innovation in established industries. Our paper identifies the success factors and challenges in creating the right environment to actively steer CVA, especially as corporations increase their entrepreneurial endeavors to drive innovation.

2. Theory

CV is a strategic process where established corporations systematically engage in entrepreneurial activities by launching internal ventures, investing in external start-ups, or forming strategic partnerships to stimulate innovation and secure long-term competitive advantage (Weiblen and Chesbrough, 2015). This process enables firms to overcome the constraints imposed by traditional organizational structures, fostering an environment conducive to rapid experimentation and developing novel (digital) business models.

2.1 CV as a Driver of Digital Business Model Innovation

In the digital era, rapid technological change and new business paradigms have made digital business model innovation a strategic priority (Joseph, Boni and Abremski, 2021). Firms use CV to accelerate this innovation by creating dedicated teams or autonomous units that function like start-ups. This approach allows corporations to bypass internal bureaucracies and speed up the development of digital business models requiring structural renewal (Waldkirch, Kammerlander and Wiedeler, 2021). CV also expands market opportunities by exploring new segments and experiences vital for digital transformation, diversifying revenue streams and enhancing competitive positions. Companies often establish venturing studios or corporate venture capital to invest in promising digital start-ups, potentially incorporating the startup's insights into their digital strategy (Jeon and Maula, 2022). Established firms have initiated internal ventures or partnered with tech companies to explore digital solutions, reshaping value chains (Hausberg and Korreck, 2020). Others have set-up internal start-up programs operating with autonomy, facilitating rapid innovation and testing new digital business models while leveraging resources from the parent company (Steiber, Alänge and Corvello, 2021). Large corporations often collaborate with external innovators through strategic partnerships; for example, traditional media may ally with digital content platforms to co-create new revenue models and distribution channels. This collection of CV models and their different objectives showcases unique governance structures. Research has tackled this issue and proposed descriptive frameworks emphasizing firms' methods to oversee CVA.

2.2 Governing CVA

Prior systematic literature reviews suggest firms struggle to manage CVA and lack a suitable governance framework (Garidis, Rossmann and Murray, 2024). The CVG model proposed by Garidis *et al.* (2025) is a descriptive framework that seeks to balance the autonomy of CSs within the environment of the parent company. This model organizes governance mechanisms into three interconnected dimensions: **(1) Structural mechanisms, (2) processes and operations, and (2) relational mechanisms,** each comprising specific mechanisms firms apply to manage autonomy in their respective areas. These dimensions collectively shape how CVs operate within corporate ecosystems while preserving their agility and innovative potential. **Structural mechanisms** shape the environment where CVs operate and affect their integration with the parent firm. These mechanisms establish boundaries that impact a CV's decision-making ability. For example, structural autonomy differs based on whether a CV is a distinct legal entity or part of corporate hierarchies. Geographic separation from headquarters and branding strategies also influence autonomy. Distance can reduce corporate oversight, while shared branding aligns market positioning, but may impose compliance restrictions. These structural choices create a "firewall" that protects CVs from bureaucracy or connects them to corporate resources.

Processes and operations involve activities and resource flows between CVs and parent firms, balancing standardized procedures and flexibility. They dictate resource management, financial support, and

administrative services. Innovation pipelines phase funding based on CV objectives and corporate goals. For instance, accelerators validate ideas before scaling, while procurement policies determine if CVs can bypass corporate purchasing protocols. These mechanisms guide innovation without stifling experimentation, but rigid processes risk undermining the agility needed for CV success.

Relational mechanisms address the interpersonal and cultural factors facilitating collaboration and knowledge exchange between CVs and their parent. These mechanisms are crucial for integrating entrepreneurial mindsets and fostering an environment where innovation can thrive. Relational mechanisms may include informal communication channels, networking opportunities, and cultivating shared values. The effectiveness of these mechanisms often determines whether structural and operational autonomy translates into tangible innovation outcomes, as they help bridge the gap between CVs' entrepreneurial ambitions and the parent firm's strategic priorities.

Garidis *et al.* (2025) present a CVG model that helps clarify how established organizations manage CV initiatives. The model details structural, operational, and relational mechanisms that support innovation. However, organizations encounter challenges in managing the dual objectives of autonomy and integration. This difficulty arises from adapting governance structures to specific contexts, which vary by organizational culture, industry, and CV objectives. As no one-size-fits-all approach exists, further research must examine the factors that enable or hinder effective implementation. This study contributes by analyzing insights from 40 practitioners on key success factors and challenges related to structures, processes, operations, and relational mechanisms in CVG.

3. Method

We aim to identify and synthesize key success factors and challenges governing CVA. Qualitative research is particularly suitable for exploring complex phenomena insufficiently covered by existing literature or theory (Kuckartz, 2019). In light of this, we adopt a qualitative research approach, utilizing semi-structured interviews widely adapted for identifying and synthesizing phenomena in CV research.

3.1 Research Design

Our research design followed a four-phase process:

3.1.1 Phase 1: Questionnaire development

Initially, we developed a semi-structured questionnaire based on prior theoretical frameworks (Garidis, Rossmann and Murray, 2024). We structured the questionnaire into the three main dimensions of CVG as described in the theory section: structures, processes and operations, and relational mechanisms. We prepared open-ended questions for each dimension to allow practitioners to elaborate freely on their experiences. Additionally, individual in-depth questions explored the background of the identified success factors, their effects, and their interrelationships with other governance dimensions.

3.1.2 Phase 2: Pretest

Before conducting the main study, we performed a pretest with five practitioners. After discussing all three governance dimensions, we openly inquired about what went well and what went wrong. Analyzing these initial results revealed that the interviewees' answers were too generic and lacked sufficient specificity. Recognizing these shortcomings in our questionnaire design, we adopted a more structured approach for the main study. Accordingly, we explicitly asked respondents to identify key success factors for each CVG dimension.

3.1.3 Phase 3: Main Study

Following the pretest insights, we conducted 40 semi-structured interviews over 6 months with CEOs and managers responsible for implementing and managing CV initiatives for digital innovation in the German-speaking DACH region. Interviewees were selected based on their extensive experience with various CV models. The sample included experts from diverse industry backgrounds such as technology firms, home appliances manufacturers, chemical and pharmaceutical companies, energy providers, insurance companies, automotive manufacturers, and consumer goods producers. All interviewees held leading roles (e.g., CV CEOs or innovation managers) and were responsible for designing or managing governance mechanisms.

To accommodate geographical dispersion, interviews were conducted via online calls. Each interview lasted 45-60 minutes. Semi-structured interviews enabled us to maintain consistency across interviews while allowing flexibility in exploring relevant topics raised by respondents.

3.1.4 Phase 4: Data Analysis

All interviews were recorded, fully transcribed, and analyzed using qualitative content analysis (Kuckartz, 2019). We used qualitative coding software (MaxQDA) to analyze the transcripts systematically. We applied high-level codes according to the three governance dimensions described in section 2 to ensure that each discussed success factor or challenge could be associated to the respective dimension. For example, we created a subcode for the structural dimension when a respondent reported a success factor for setting up structural mechanisms. After coding all transcripts, we synthesized the coded segments according to the identified success factors and challenges in CVG. This synthesis aimed to capture common patterns across respondents' experiences while recognizing individual differences. This rigorous methodological approach enabled us to develop an empirically grounded understanding of the success factors and challenges in CVG.

4. Results

The following section presents the main findings from our analysis, structured according to the three governance dimensions: structures, processes and operations, and relational mechanisms. Each subsection represents one code and synthesizes the critical success factors and challenges identified by interviewees within its respective dimension. This organization enables a clear comparison of how CVG influences the autonomy and effectiveness of CVs. The results provide an empirically grounded basis for the discussion and practical recommendations that follow.

4.1 Structures

Structural mechanisms form the organizational foundation upon which successful CV initiatives are built. These mechanisms define how CVs are positioned within or alongside the parent organization and establish the formal relationships that enable innovation to flourish.

4.1.1 Management Support

Management support is a vital success factor in corporate entrepreneurship and innovation (Lin, Chen and Lin, 2017). Our research adds nuanced insights on management's role in corporate startup governance. Half of the interviewees indicated that management backing is crucial for CVs to gain legitimacy and necessary resources. Respondents highlighted instances where strong sponsors opened doors and connected the VC to departments lacking personal networks for resource access. When departments were unresponsive, the executive sponsor intervened, expediting corporate communication. They also facilitated access to additional financial resources. Strong executive mandates empower CVs to operate outside standard constraints, fostering innovation despite potential pushback from other units. Access to upper management further simplified circumventing corporate procurement policies. Management backing was especially relevant for CVs without clear governance models.

4.1.2 Clear Governance Models

Effective CVs thrive on governance models specifically designed for their distinct needs. In conventional organizations, traditional governance methods frequently hinder innovation due to overwhelming controls and bureaucracy. Those who participated in the early stages of CV initiatives highlighted that identifying a suitable governance model to meet autonomy requirements was a key challenge. CV necessitates governance frameworks that offer corporate resources and sustain the agility essential for innovation. In contexts lacking these structures, participants spent considerable time figuring out how to access corporate resources or comprehend processes described in section 4.2.2.

4.1.3 Objectives and Organizational Placement

The placement of CV within the broader organizational framework greatly influences their success. Interviewees frequently noted that CVs located too near core business units tend to encounter pushback from established corporate processes during their exploratory activities. In contrast, those situated too far away face difficulties in integration. One respondent noted that transferring the innovation to the business units is challenging because the CV unit only handled initial development, not implementation or maintenance.

4.2 Processes and Operations

This section summarizes the key challenges and success factors in processes and operations. The data reveals several critical areas where CV face operational barriers and highlights potential solutions identified by practitioners in the field.

4.2.1 Resource Allocation and Prioritization

Resource allocation is a central operational challenge for CV initiatives. Middle management resistance, driven by misaligned incentives and a focus on short-term goals, often limits support for innovation activities and makes securing time and resources for CVs difficult. Budget constraints further hinder progress, as innovation funds are typically subject to complex approval processes and are often insufficient for meaningful experimentation. Additionally, balancing program activities and competing priorities, such as external client work versus internal innovation, creates further obstacles, making resource commitment unpredictable and limiting the ability of CV teams to drive substantial progress.

4.2.2 Corporate Processes and Bureaucracy

Corporate processes' complexity and slow pace hinder agility and decision-making in CVs. Respondents identify several procedural barriers: Software, hardware, or procurement usually involves lengthy approvals and complex requirements. What could be purchased instantly with a credit card can take weeks or months through corporate channels.

Finding services in large corporations is challenging. CVs often struggle to navigate the organizational maze to locate necessary resources or expertise. Employment processes lasting months delay essential team building, especially when CVs need to grow quickly. Regulatory compliance adds complications, particularly for firms with strict procurement rules. The gap between corporate timelines and startup needs is significant. As noted by one respondent, CVs can "starve" if forced to follow traditional corporate processes.

4.2.3 Building Independent Capabilities

Establishing dedicated resources is essential instead of relying on standard corporate functions. Respondents highlight the need for specific IT, marketing, and other functions within the CV. IT autonomy is critical; it must operate independently from corporate IT, which is hindered by extensive regulations that disrupt CVs' technology needs. The need for sales and marketing tailored to CVs is often highlighted, as corporate sales channels frequently struggle to meet CV requirements. Respondents want dedicated sales targeting CVs' products, empowered to engage customers without corporate marketing approval. These teams should conduct market research and chase sales opportunities without distractions from standard products.

4.3 Relational Mechanisms

Relational mechanisms play a pivotal role in shaping challenges and success factors experienced by CVs. The following synthesis brings together the main themes that emerged from the interviews, focusing on the interplay between networks, culture, interdisciplinary work, interdepartmental dynamics, and the acceptance of external innovation.

4.3.1 Network and Relationship to Parent Firm

A strong internal network and established relationships within the parent company are repeatedly highlighted as critical for the success of CVs. Teams with long-standing employees benefit from their deep organizational knowledge and contacts, often expediting processes and problem-solving. These individuals know whom to approach for specific needs, reducing the time to navigate corporate structures. However, newcomers without such networks can face significant hurdles, as building trust from scratch is time-consuming. Once established, trust acts as a buffer in turbulence and is maintained through regular communication. Top management support legitimizes innovation activities and provides the necessary backing to overcome organizational inertia. At the same time, innovation teams must carefully balance their role as challengers to the status quo, ensuring that their position is perceived as value-adding rather than disruptive or elitist, which requires deliberate framing and communication.

4.3.2 Building Culture

Developing a distinct yet compatible culture within the CV is seen as essential. Successful teams maintain core values aligned with the parent company while fostering an environment that encourages entrepreneurial thinking, autonomy, and professional conduct. This cultural balance allows for integration and independence, supporting innovation while avoiding alienation from the parent organization. Teams perceived as too exclusive or privileged risk creating resentment among other departments; thus, efforts are made to avoid overt displays of special status, such as luxurious offices. The entrepreneurial spirit, while encouraged, can also lead to friction when it clashes with established corporate processes and decision-making hierarchies. Navigating these tensions requires structural support for autonomy and an acceptance that some degree of frustration is inherent in innovation work.

4.3.3 Interdisciplinary Teams and Start-up Ecosystem

Diversity within teams is consistently identified as a strength. The most effective groups combine a range of professional backgrounds, ages, and international experiences, which broadens perspectives and enhances problem-solving capabilities. The careful selection and composition of teams are considered crucial, with successful CVs blending internal veterans with external hires to balance institutional knowledge and fresh ideas. Engaging with the broader start-up ecosystem is also valued, as it provides opportunities for learning and benchmarking against peers. However, forming truly interdisciplinary teams remains a challenge.

4.3.4 Interdepartmental Dynamics

The relationship between innovation teams and operational business units is characterized by cooperation and competition. Early involvement of business units in innovation projects is seen as a way to build ownership and commitment, gradually transferring responsibility from the CV to the operational side. Transparent communication about ongoing activities and clear demonstration of how innovation supports business unit goals help to foster alignment. Nevertheless, business units often prioritize core operations and immediate customer needs, which can result in innovation projects being sidelined. Misaligned incentives, where operational teams are rewarded for short-term results rather than long-term innovation, create additional barriers. Resource competition is a recurring issue, with innovation initiatives sometimes losing to more pressing business demands. Navigating these dynamics requires persistent stakeholder management, empathy for different perspectives, and ongoing efforts to build mutual understanding and support.

5. Discussion

Our research offers empirical insights into how CVG is effectively implemented, building upon the framework set by Garidis et al. (2025). In response to our first research question, management support is the most frequently mentioned element across various governance dimensions. This support operates through several avenues: granting legitimacy, enhancing resource accessibility, allowing exemptions from strict processes, and fostering an environment for experimentation. Additional vital success factors include creating clear CVG models tailored to the specific needs of CVs, establishing independent capabilities in essential areas, and building robust networks that bridge CV and corporate environments.

For our second research question about the challenges related to governing CVA, resource allocation emerges as the primary obstacle. Middle management resistance, budget restraints, conflicting priorities, and misaligned incentive systems highlight this issue. These obstacles are particularly pronounced in hybrid governance models, where CVs rely on corporate resources while striving for independent innovation goals.

5.1 Balancing Contradictory Forces Through CVG

The findings demonstrate that effective CVG is characterized by a delicate balance between seemingly contradictory forces: autonomy and integration, exploration and exploitation, agility and control. This tension manifests as a "tug-of-war" across all three governance dimensions examined in our study. Our research contributes to understanding how corporations navigate this tension through specific governance mechanisms.

In the structural dimension, the positioning of CVs within the organizational framework illustrates this balancing act. CVs close to core business units encounter resistance from established corporate processes during exploration, while those far away face integration difficulties. This finding supports the structural ambidexterity

concept noted in previous research but adds nuance by highlighting that the optimal structural configuration depends on the specific innovation objectives and corporate context (O'Reilly and Tushman, 2008).

Management support emerges as particularly critical for establishing this balance. While management support has been identified in previous research as necessary for innovation initiatives generally, our study reveals its specific role in CVG: it legitimizes CVs within the broader organization, facilitates access to resources, and provides the necessary backing to overcome organizational inertia. This clarifies how management support functions as a governance mechanism that enables autonomy.

5.2 Process Tensions: The CV Paradox

The processes and operations dimension reveals a fundamental paradox in CVG: corporate processes designed for efficiency inherently conflict with the exploratory nature of CV activities. This paradox manifests most prominently in resource allocation challenges, where middle management incentives rarely align with innovation goals. The severity of process-related challenges varies significantly based on the governance model employed. CVs established as separate legal entities with dedicated resources experience fewer process-related constraints than those embedded within corporate structures. However, our findings suggest that complete separation is not universally optimal, as it can limit access to valuable corporate resources and expertise. This indicates that process governance should be tailored to the specific innovation objectives, with some CVs benefiting from closer integration despite the associated bureaucratic challenges. Future research should focus on the relationship between governance and specific innovation objectives.

5.3 Relational Mechanisms: Beyond Formal CVG

Our findings on relational mechanisms reveal their fundamental importance in effective CVG, extending beyond the formal structures and processes. Strong internal networks, cultural compatibility, and diverse team composition emerged as critical success factors. These relational elements serve as the "social infrastructure" that enables CVs to navigate corporate complexity and build necessary support for innovation initiatives.

Particularly noteworthy is the finding that successful CVs typically blend internal veterans with external hires, balancing institutional knowledge with fresh perspectives. This mixed staffing approach facilitates knowledge transfer between the CV and parent organization, as high autonomy can impede knowledge exchange (Garidis *et al.*, 2025). Cultural differences between CV and parent organizations were not widely perceived as significant barriers in our sample.

5.4 Guidelines for Practitioners

Addressing our third research question, our findings suggest that governance mechanisms should be designed with strategic intent. The optimal approach depends on the specific innovation objectives, corporate context, and desired balance between autonomy and integration. We propose the following guidelines for practitioners seeking to establish effective CVG:

- **Tailor governance to innovation objective**: The optimal governance approach should align with the specific innovation objectives. CVs focused on incremental innovation that will be integrated into existing business units may benefit from closer structural connections, while those pursuing disruptive business models likely require greater autonomy.
- **Secure and leverage executive sponsorship**: Management support should be formalized through explicit sponsorship agreements clarifying autonomy, resource access, and performance metrics expectations. Executive sponsors should actively intervene to remove barriers rather than merely providing verbal endorsement.
- **Implement selective process decoupling**: Rather than forcing CVs to adhere to all standard corporate processes or establishing complete independence, identify which specific processes are most restrictive to innovation and create alternative approaches for these areas. In particular, establish autonomous capabilities for IT, procurement, and marketing.
- **Design appropriate incentive structures**: Ensure that individuals supporting CV initiatives are rewarded for contributing to innovation outcomes. This may require modified performance metrics for both CV personnel and corporate staff who provide resources to CV.

- **Cultivate cross-boundary networks**: Actively develop relationships between CV teams and key corporate stakeholders. These networks facilitate resource access, enhance knowledge transfer, and build support for eventual innovation adoption.
- **Build diverse, complementary teams**: Combine individuals with deep corporate knowledge and external hires with fresh perspectives and specialized expertise. This diversity enhances problem-solving capabilities and facilitates both innovation development and corporate integration.
- **Communicate value creation narratives**: Develop and consistently communicate narratives explaining how CVs create value for the corporation. These narratives should address short-term contributions and long-term strategic benefits to maintain support during challenging periods.

6. Conclusion and Future Research

This study advances our understanding of CVG by providing empirical insights into the key success factors and challenges practitioners face. By examining the experiences of 40 experts across the DACH region, we identified management support, clear governance models, autonomous capabilities, and strong networks as critical success factors. Conversely, resource allocation challenges, process misalignments, and organizational resistance emerged as significant barriers.

These findings address the research questions posed at the outset of this study. We identified critical success factors for CV initiatives, highlighted the main challenges in governing CVA, and derived implications for CV management through actionable guidelines for practitioners. The insights extend beyond previous descriptive frameworks by providing evidence of how governance mechanisms function in practice and which factors most significantly influence outcomes.

Despite its contributions, this study has limitations that provide opportunities for future research. The focus on the DACH region limits the generalizability of findings to other geographic and cultural contexts. An important direction for future research is the development of practical tools to help organizations design effective governance for their specific CV initiatives. Based on our findings, we envision a tool that would:

1. Assess strategic innovation objectives and corporate context
2. Evaluate current governance mechanisms across structural, operational, and relational dimensions
3. Identify gaps and misalignments between strategic intent and governance approaches
4. Recommend specific governance adjustments to enhance CV performance

In conclusion, effective CVG requires a deliberate approach that balances autonomy and integration through carefully designed mechanisms across structural, operational, and relational dimensions. By understanding the key success factors and challenges identified in this study, organizations can enhance their capacity to leverage CV for digital innovation. The findings provide a foundation for both improved practice and further research, contributing to the evolution of corporate entrepreneurship in an increasingly digital business environment.

Ethics Declaration

We received ethical approval for this research from our university.

AI Declaration

We utilized www.grammarly.com for spellchecking, grammar corrections, and improving our writing.

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Unlocking Startup Funding: The Role of Alliances, Patenting, and Network in Entrepreneurial Support Ecosystems

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Abstract: This study explores critical determinants influencing startups' equity financing outcomes, focusing particularly on the roles of strategic alliances, patenting activities, and network dynamics generated within incubators, which constitute a specific form of Entrepreneurial Support Organizations. Leveraging an extensive dataset of 238 startups incubated at European Space Agency Business Incubation Centres (ESA BICs), we apply probit regression and Weibull Accelerated Failure Time (AFT) models. Findings reveal that R&D alliances established during incubation markedly enhance both the likelihood and timing of securing equity investments by effectively signalling innovation capability to investors. Conversely, commercial alliances display negligible impact, underscoring their limited signalling potential in technology-focused environments. Interestingly, patenting activities undertaken during incubation negatively affect equity financing prospects. This intriguingly result contributes to existing debates by highlighting that while patents may initially serve as valuable signals, their influence can diminish over time as information asymmetries decrease. Additionally, this study empirically substantiates the "Bridging Effect", demonstrating that extensive incubators networks significantly promote alliance formation among incubated startups. These insights hold theoretical significance and practical implications for entrepreneurs, incubator managers and policymakers striving to optimize support structures within entrepreneurial ecosystems.

Keywords: Entrepreneurial Ecosystems, Equity Financing, Incubators, Startup Growth, Patenting Activities, Strategic Alliances.

1. Introduction

Startups are increasingly acknowledged as pivotal catalysts for innovation and economic advancement, although their initial growth trajectories are critically influenced by their capacity to attract key resources, obtain financial capital, and forge effective strategic partnerships. Entrepreneurial ecosystems (EEs) profoundly shape these early-stage success factors through a dynamic interplay of supportive policies, developed infrastructure, accessible human capital, and positive cultural attitudes towards entrepreneurship (Spigel, 2017; Stam & Van de Ven, 2021). Within these ecosystems, Entrepreneurial Support Organizations (ESOs), particularly incubators, are increasingly recognized as pivotal facilitators of startup success, notably through their support in securing equity financing (Bergman & McMullen, 2022). Central to this process are strategic alliances and patenting activities, which significantly influence investor perceptions (Ozmel et al., 2013). Although incubators are recognized for providing essential resources, networks, and credibility, there is significant opportunity to deepen our understanding of how startups' strategic alliances and patenting activities established during incubation specifically influence their equity financing. Given the mixed evidence on the impact of different alliance types and the ambiguous outcomes associated with patent activities, exploring these mechanisms in greater detail within incubator environments represents valuable theoretical and practical opportunities. Theoretically, this analysis enhances our understanding of entrepreneurial ecosystems by shedding light on how startup-specific strategic behaviours, particularly alliance formation and patenting activities, influence resource acquisition dynamics, capability signalling, and ultimately equity financing outcomes, as well as clarifying the facilitating role played by entrepreneurial support organizations within these dynamics. Practically, enhanced insights enable incubator managers and entrepreneurs to strategically select and manage partnerships and intellectual property, thereby maximizing startup attractiveness to investors. The space economy, characterized by substantial capital needs, technological complexity, and extensive collaboration requirements, provides an ideal empirical setting for addressing these research opportunities (Colombo & Delmastro, 2002). In particular, the European Space Agency Business Incubation Centres (ESA BICs), specialized incubators dedicated to supporting startups in the space sector, offer a highly relevant context for examining how incubator-specific networks and structured support mechanisms impact startup equity financing outcomes. This study empirically investigates 238 startups incubated within ESA BICs between 2016 and 2022, employing probit regression and Weibull

Accelerated Failure Time models. The findings significantly contribute to entrepreneurial ecosystem literature by confirming the pivotal role of R&D alliances in enhancing both the likelihood and speed of securing equity financing, underscoring their essential signalling value to investors. Conversely, commercial alliances are found to lack consistent significance, suggesting a comparatively lower signalling value in investment decisions. Moreover, this research empirically validates the "bridging effect", illustrating how the breadth and robustness of an incubator's network enhance the likelihood of alliance formation among incubated startups, emphasizing the importance of network scale. Surprisingly, concerning the contribution of patenting activities, this study finds a negative impact on the likelihood of obtaining equity financing. This result aligns with Hoenen et al. (2014), who suggest that patenting activity significantly influences the first round of financing but not subsequent rounds, as informational asymmetries between investors and startups decrease over time. Thus, it becomes crucial to consider the specific startup context and investor characteristics when evaluating the effectiveness of patents as a tool for attracting financing. Together, these findings provide meaningful theoretical advancements and actionable guidance for entrepreneurs, incubator managers and policymakers committed to fostering robust entrepreneurial ecosystems.

2. Theoretical Background

2.1 Entrepreneurial Ecosystems

Entrepreneurial ecosystems (EEs) encompass interconnected networks of diverse actors, institutions, and processes that collectively promote entrepreneurial activities and startup growth (Isenberg, 2010; Mason & Brown, 2014; Stam & Van de Ven, 2021). These ecosystems are characterized by the presence of various stakeholders, including entrepreneurs, investors, corporations, universities, public sector entities, financial institutions, and support organizations, each playing critical roles to enhance overall ecosystem vibrancy (Autio et al., 2017; Brown & Mason, 2017; Spigel & Harrison, 2017). Crucial dimensions of entrepreneurial ecosystems include financial resources, accessible markets, robust physical infrastructures, supportive regulatory frameworks, skilled human capital, and an entrepreneurial culture that values risk-taking and innovation (Spigel, 2017; Colombo & Piva, 2010; Wurth et al., 2022). Effective entrepreneurial ecosystems are dynamic, adaptable, and resilient, capable of responding to evolving market conditions and technological advancements (Autio et al., 2017; Stam & Van de Ven, 2021).

2.2 Entrepreneurial Support Organizations

Entrepreneurial Support Organizations (ESOs) represent specialized intermediary organizations within Entrepreneurial Ecosystems that offer targeted resources and strategic services aimed at fostering startup growth and enhancing their likelihood of survival. These organizations take various forms, including incubators, accelerators, co-working spaces, business development agencies, and innovation hubs, each providing distinct yet complementary types of support (Hausberg & Korreck, 2020; Hochberg, 2016; Clayton et al., 2018a). ESOs primarily aim to address startups' early-stage vulnerabilities by facilitating mentorship opportunities, structured training programs, and extensive networking activities, alongside providing critical access to both financial and non-financial resources (Clayton et al., 2018a; Hausberg & Korreck, 2020). Through their intervention, ESOs significantly reduce informational asymmetries between startups and external stakeholders, enhance the credibility and perceived legitimacy of young ventures, and contribute directly to the availability and efficient mobilization of key resources within entrepreneurial ecosystems (Hochberg, 2016). Consequently, ESOs play an instrumental role in promoting resilience, adaptability, and sustained growth across Entrepreneurial Ecosystem.

2.3 Incubators

Incubators represent a crucial category of Entrepreneurial Support Organizations (ESOs) designed to nurture early-stage ventures by providing structured resources and tailored support services aimed at overcoming typical startup challenges (Hausberg & Korreck, 2020; Clayton et al., 2018a). Primary objectives of incubators include reducing startup failure rates, facilitating growth, enhancing entrepreneurial skills, and promoting innovation through resource provision and strategic guidance (Mian et al., 2016; Hochberg, 2016). Incubators generally offer physical facilities, mentorship, managerial training, business advisory services, and extensive networks linking startups with investors, industry experts, and potential strategic partners (Clayton et al., 2018a; Grilli & Marzano, 2023). Incubators can be categorized based on their affiliation and objectives. University-based incubators leverage academic knowledge and research capabilities to commercialize innovations and foster academic entrepreneurship (Campbell & Allen, 1987; Mian, 1997). Corporate incubators focus on accelerating

innovation aligned with the strategic objectives of their parent companies, often facilitating collaborations between startups and corporations (Bruneel & Ratinho, 2012). Public incubators generally aim to foster regional economic development, supporting ventures through subsidized resources and specialized programs targeting strategic sectors (Ferreiro-Seoane et al., 2018; Zhdanova & Milyaev, 2016).

2.4 Alliances and Patenting

Alliances and patenting activities constitute critical strategic resources that significantly shape startup growth trajectories and long-term sustainability. Specifically, strategic alliances conceptualized as collaborative partnerships established between independent organizations, allow startups to combine complementary assets, distribute risks, and leverage collective expertise effectively (Gulati, 1998; Das & Teng, 2000; Rothaermel & Deeds, 2006). By facilitating rapid innovation processes and accelerating market entry, these alliances grant startups access to crucial external resources, including advanced technologies, specialized industry knowledge, established market channels, and financial support. Consequently, alliances help mitigate inherent resource constraints and expedite developmental cycles, markedly enhancing startups' competitive positioning and market viability. Additionally, strategic alliances serve as critical signals of legitimacy and credibility to external stakeholders, such as investors, customers, and suppliers, thereby further bolstering the startups' potential for sustained growth (Colombo et al., 2006; Ozmel et al., 2013; Stuart et al., 1999; Gulati & Higgins, 2003).

Patenting activities represent another pivotal strategic resource, serving both to secure competitive advantage and to communicate technological capability to external stakeholders. Patents provide legal protection for intellectual property, enabling startups to safeguard their technological advancements from competitors, and facilitating the commercialization of innovations (Cockburn & MacGarvie, 2009; Hsu & Ziedonis, 2013; Mann & Sager, 2007). Beyond their direct economic benefits, patents also function importantly as signalling mechanisms to investors. Specifically, patents reduce informational asymmetries by serving as credible indicators of a startup’s potential for technological innovation and market success, particularly in high-tech and knowledge-intensive sectors (Hoenen et al., 2014). However, literature suggests that the signalling strength of patents is not static; rather, it may diminish as investors accumulate information about the startup across successive financing rounds, thereby reducing the patents' incremental value as indicators of firm quality (Hoenen et al., 2014). The signalling effectiveness of patents is particularly pronounced in early investment rounds when informational asymmetries between entrepreneurs and venture capitalists are greatest, yet this effect weakens as these asymmetries lessen over time and investors rely on direct firm observations and monitoring (Hoenen et al., 2014).

3. Hypothesis Development

Drawing upon the insights outlined in the previous sections, incubators emerge as pivotal actors within entrepreneurial ecosystems, significantly shaping startups’ growth trajectories by providing structured resources, networks, and legitimacy (Spigel, 2017; Bergman & McMullen, 2022). Consistent with existing literature (Colombo et al., 2006; Ozmel et al., 2013), we classify strategic alliances into two categories: R&D alliances, aimed at fostering technological innovation, and commercial alliances, which primarily facilitate market access.

Literature highlights R&D alliances as instrumental in enhancing startups' innovation capabilities and signalling technological competence, factors typically valued by equity investors (Baum et al., 2000; Rothaermel & Thursby, 2005; Ozmel et al., 2013). Given incubators' explicit focus on technology and innovation-driven environments, we posit that R&D alliances formed during incubation periods could further amplify startups' attractiveness to investors, thereby positively influencing their equity financing prospects. Thus, we propose:

Hypothesis 1a: *Startups that establish R&D alliances during their incubation period are more likely to attract additional equity financing rounds.*

Conversely, commercial alliances primarily emphasize immediate market access and revenue generation rather than technological innovation and long-term competitive advantage (Colombo et al., 2006; Rothaermel & Deeds, 2006). Due to this inherent focus, commercial alliances likely provide weaker signals regarding startups' innovative capabilities and growth potential, attributes particularly valued by equity investors. Accordingly, we suggest:

Hypothesis 1b: *Startups that establish commercial alliances during their incubation period do not exhibit an increased likelihood of attracting additional equity financing rounds.*

Strategic alliances influence not only the likelihood but also the timing of equity financing. Specifically, the explicit signalling of innovation capabilities inherent in R&D alliances can considerably reduce investors' perceived risk, leading to faster investment decision-making processes (Baum et al., 2000; Rothaermel & Thursby, 2005). Consequently, we hypothesize:

Hypothesis 2a: *Startups that establish R&D alliances during their incubation period experience accelerated timing of equity financing rounds.*

Given that commercial alliances inherently focus on market-oriented goals rather than technological advancement, they may offer weaker signals of innovation potential and thus have limited capacity to reduce investor uncertainty or expedite equity investment decisions. Consequently, we hypothesize:

Hypothesis 2b: *Startups that establish commercial alliances during their incubation period do not experience accelerated timing of equity financing rounds.*

Additionally, incubators support startups in establishing robust patent portfolios, which offer legally protected evidence of technological strength and innovation capability, significantly reducing investor uncertainty (Hsu & Ziedonis, 2013; Cockburn & MacGarvie, 2009). Given the structured intellectual property support typically provided by incubators, we anticipate patenting activities during incubation to positively influence equity investment prospects. Hence, we formulate:

Hypothesis 3: *Startups that develop extensive patent portfolios during their incubation period are more likely to attract additional equity financing rounds.*

Finally, the effectiveness of alliance formation is also dependent on the composition and size of incubator networks. According to the principle of network externalities, denser and broader networks offer enhanced resource availability, foster credibility, and facilitate knowledge spillovers, thus increasing alliance opportunities for startups (Baum et al., 2000; Ozmel et al., 2013). Therefore, we posit:

Hypothesis 4: *The number of startup alliances is positively correlated with the number of incubator partners.*

4. Methodology

4.1 Data Collection

The dataset constructed for this study encompasses 238 startups incubated within the European Space Agency Business Incubation Centres (ESA BICs) between 2016 and 2022. Initial data collection involved extracting startup details from the official ESA BIC website, integrating comprehensive information on equity funding rounds sourced from PitchBook, and incorporating industry-level data from Eurostat. To ensure accuracy and completeness, extensive cross-verification and manual validation were performed, involving checking startup legal names, websites, and official announcements from ESA BICs. Additional variables such as patent filings, startup age, presence of local space clusters, and characteristics of ESA BIC partners were meticulously gathered through startup websites, Wayback Machine archives, official news sources, and other credible databases.

4.2 Econometric Models

The empirical investigation employs three econometric models, each targeting a specific dimension of startup equity financing dynamics and network interactions within incubation contexts. Before running the models, we conducted standard diagnostic checks, including tests for multicollinearity, homoscedasticity, and normality of residuals, ensuring the robustness of our analysis. The following sections elaborate on each model's methodological framework, clearly delineating dependent variables, independent variables, control variables, and robustness checks.

4.2.1 Model 1: Likelihood of Obtaining Equity Financing

The first model employs a probit regression to assess the probability of startups obtaining subsequent equity financing rounds after incubation. Probit regression model is particularly suitable for binary dependent variables, modelling the probability of an event occurring based on a set of explanatory variables. The primary objective of this model is to identify the strategic and contextual factors that significantly influence a startup’s probability of obtaining follow-on equity investments.

4.2.2 Dependent Variable

To assess whether startups are able to secure further financial resources after completing incubation, this model uses a binary dependent variable (*dummy_equity_after*) that takes the value 1 if the startup obtained an equity investment following its ESA BIC incubation, and 0 otherwise. This variable reflects the firm's ability to continue attracting external investors, often considered a signal of credibility and scalability. In the context of incubated startups, follow-on funding represents a tangible sign of validation from the market, and its occurrence may depend not only on firm-internal factors but also on network-related and ecosystem-level dynamics.

4.2.3 Independent Variables

The main explanatory variables include the presence of R&D alliances (*dummy_R&D_alliances*), commercial alliances (*dummy_commercial_alliances*), and alliances with actors belonging to the ESA BIC network (*dummy_alliances_same_ESABIC*). Moreover, the number of patents filed during incubation (*patents_during*) is used to capture innovation outputs generated through the incubation process. These variables allow the model to test whether engagement in collaborative innovation or knowledge-sharing activities impacts startups' fundraising outcomes.

4.2.4 Control Variables

The model includes a comprehensive set of control variables that account for prior startup conditions, incubation characteristics, and broader contextual elements. These include prior financing before incubation (*dummy_financing*), additional incubation experiences (*dummy_extra_incubator*), startup age at the beginning of the ESA BIC program (*age_startup*), and the ESA BIC's maturity (*age_ESABIC*). Incubation duration (*year_incubation*) is also included. The model controls for pre-existing technological capabilities through the number of patents filed before incubation (*patents_before*). Network characteristics are captured via the number of ESA BIC partners (*alliances_ESABIC*) and partner type composition (universities, public bodies, and industrial firms). The presence of a local space cluster (*dummy_space_cluster*) is added to account for spatial proximity to specialized knowledge and market actors.

4.2.5 Robustness Checks

To ensure the robustness of the findings, additional probit regressions with robust standard errors were estimated. The models were also rerun after winsorizing the variables at different thresholds (1%, 5%, and 10%) and removing potentially collinear or context-specific predictors. Cross-validation techniques were employed to test model generalizability.

4.2.6 Model 2: Timing of Equity Financing

The second model employs the Weibull Accelerated Failure Time (AFT) to examine factors influencing how rapidly startups secure equity funding after incubation. The Weibull AFT model is advantageous for modelling durations, particularly where the timing of events is a crucial aspect of the investigation. This approach allows estimation of whether specific factors accelerate or delay the occurrence of equity financing events, thus providing strategic insights into funding dynamics.

4.2.7 Dependent Variable

The dependent variable (*time_equity_after*) represents the duration, measured in months, from the start of the incubation period until the first subsequent equity financing event. This measurement effectively captures the temporal dimension of funding acquisition, offering insights into the strategic and operational efficiency of startups in attracting investment.

4.2.8 Independent Variables

The key independent variables in this model include the number of R&D alliances (*R&D_alliances*) and commercial alliances (*commercial_alliances*) formed during incubation. These variables aim to capture different strategic partnership types, reflecting how various collaborative interactions influence the visibility, perceived value, and investment readiness of startups.

4.2.9 Control Variables

A consistent set of control variables is introduced, capturing both startup-specific and ecosystem-level characteristics. These include prior funding (*dummy_financing*), participation in other incubators (*extra_incubators*), startup age at entry (*age_startup*), and ESA BIC maturity (*age_ESABIC*). The length of the incubation period (*year_incubation*) and the number of ESA BIC partners (*alliances_ESABIC*) are also considered. To capture pre-incubation financial momentum, the time since the last equity round before incubation (*time_equity_before_shifted*) is included. Lastly, macroeconomic context is controlled using industry-country GVA growth rates (*GVA_CAGR_industry_country*).

4.2.10 Robustness Checks

Model robustness was confirmed by evaluating alternative distributions against the Weibull distribution, examining pseudo-residuals, and testing alternative specifications for key alliance and patent variables.

4.2.11 Model 3: Alliance Formation with ESA BIC Partners

The third model applies probit regression to explore the "bridging effect" assessing specifically how the structural characteristics of ESA BIC networks influence startups' likelihood of forming alliances within their host ESA BIC's partner network. This analysis provides insights into the network-driven dynamics of collaboration and resource access within incubation contexts.

4.2.12 Dependent Variable

The dependent variable (*dummy_alliances_same_ESABIC*) is a binary indicator reflecting whether a startup forms at least one alliance with partners officially affiliated with its ESA BIC. This measure evaluates the effectiveness of incubator networks in fostering internal collaborative ties.

4.2.13 Independent Variables

The independent variables focus on structural characteristics of the ESA BIC partner network, including the total number of partners (*alliances_ESABIC*) and the presence of specific types of partners such as universities (*dummy_university_alliances_ESABIC*) and public organizations (*dummy_public_alliances_ESABIC*). These variables enable an examination of how both network density and partner diversity influence startups' alliance formation behaviors.

4.2.14 Control Variables

Several startup-specific and incubation-related characteristics are controlled for, including previous equity financing (*dummy_equity_before*), previous support from other incubators (*dummy_extra_incubator*), and prior funding received (*dummy_financing*). Age of the startup and the incubator at the moment of entry (*age_startup*, *age_ESABIC*), as well as the incubation duration (*year_incubation*), are included. Patent filings before and during incubation (*patents_before*, *patents_during*) account for innovation capacity. A dummy for the presence of local clusters (*dummy_space_cluster*) and macroeconomic trends via (*GVA_CAGR_industry_country*)are also included.

4.2.15 Robustness Checks

Robust probit models were employed, and sensitivity checks were conducted by testing different levels of winsorization (5%, 1%) and re-estimating the model after excluding potentially endogenous predictors. These checks confirmed the reliability of the main results.

5. Results

The following tables present comprehensive results for the three econometric models described in the previous methodological section. Table 1 summarizes the probit regression analysis examining the likelihood of obtaining additional equity financing rounds. Results highlight significant positive impacts of R&D alliances, additional incubation experiences, alliances with university partners, the presence of a local space cluster, and industry-country growth rates, alongside significant negative associations with patents filed during incubation and startup age. Table 2 details the outcomes of the Weibull Accelerated Failure Time (AFT) model, indicating that forming R&D alliances, obtaining prior financing, additional incubation experiences, higher incubator maturity, longer

incubation periods, and a greater number of ESA BIC partners significantly accelerate the timing of equity funding. Conversely, longer intervals since previous financing rounds delay subsequent funding. Lastly, Table 3 illustrates the probit regression results related to the "bridging effect" revealing that the number of ESA BIC partners, prior financing, additional incubator experiences, and patents filed during incubation positively influence alliance formation with ESA BIC partners, whereas older startup age, higher incubator maturity, and longer incubation periods negatively impact this likelihood.

Table 1: Model 1 - Probit Regression - Likelihood of Additional Equity Financing.

Variable	Coefficient	Std. Error	p-value
dummy_R&D_alliances	1.57	0.59	0.008**
dummy_commercial_alliances	0.41	0.50	0.414
patents_during (sqrt)	-1.46	0.66	0.027**
dummy_financing	0.18	0.66	0.780
dummy_extra_incubator	1.50	0.45	0.001**
age_startup (sqrt)	-1.14	0.40	0.004**
age_ESABIC (sqrt)	0.14	0.30	0.648
dummy_space_cluster	1.43	0.63	0.023**
patents_before	-0.44	0.42	0.288
year_incubation	-1.47	1.17	0.206
alliances_ESABIC (sqrt)	-0.30	0.16	0.061*
dummy_university_alliances_ESABIC	1.63	0.68	0.017**
dummy_public_alliances_ESABIC	-0.78	0.53	0.139
GVA_CAGR_industry_country	2.38	0.77	0.002**
Pseudo R-squared: 0.4700			** p-value < 5%
LLR p-value: 0.0004079			*p-value < 10%

Table 2: Model 2 - Weilbull AFT (Timing of Equity Financing)

Variable	Coefficient	Std. Error	p-value
R&D_alliances (sqrt)	-0.35	0.11	0.001**
commercial_alliances (sqrt)	0.78	0.87	0.368
time_equity_before_shifted (sqrt)	-0.64	0.21	0.002**
dummy_financing	-0.28	0.08	0.000**
extra_incubators (sqrt)	-0.29	0.13	0.022**
age_startup (sqrt)	-0.17	0.11	0.130
age_ESABIC (sqrt)	0.52	0.14	0.000**
year_incubation (sqrt)	0.31	0.11	0.005**
alliances_ESABIC (sqrt)	0.49	0.21	0.022**
GVA_CAGR_industry_country (sqrt)	0.08	0.15	0.586
Final model C-index: 0.7755			** p-value < 5%
Weibull AFT AIC: 1765.08			*p-value < 10%

Table 3: Model 3 - Probit Regression (Bridging Effect of ESA BIC Networks)

Variable	Coefficient	Std. Error	p-value
alliances_ESABIC (sqrt)	0.23	0.11	0.038**
dummy_university_alliances_ESABIC	0.73	0.51	0.147
dummy_public_alliances_ESABIC	-0.10	0.30	0.750
dummy_financing	0.73	0.32	0.021**
dummy_extra_incubator	0.77	0.28	0.005**
dummy_equity_before	-0.19	0.32	0.549
age_startup (sqrt)	-0.48	0.23	0.039**
age_ESABIC(sqrt)	-0.38	0.16	0.021**
dummy_space_cluster	-0.13	0.73	0.860
patents_during (sqrt)	0.30	0.17	0.082*
patents_before (sqrt)	-0.38	0.25	0.118
GVA_CAGR_industry_country (sqrt)	2.55	2.41	0.290
year_incubation(sqrt)	-1.30	0.44	0.003**
Pseudo R-squared: 0.3861			** p-value < 5%
LLR p-value: 2.95E-08			*p-value < 10%

6. Discussion

The empirical analysis provides clear evidence concerning our initial hypotheses and contributes valuable insights to the understanding of startup equity financing dynamics. The hypothesis suggesting that R&D alliances formed during incubation positively influence the likelihood of obtaining additional equity financing (Hypothesis 1a) is supported by our results. The probit regression analysis indicates a significant positive relationship, consistent with existing literature highlighting the strong signalling value of R&D alliances to investors (Baum et al., 2000; Rothaermel & Deeds, 2006). In contrast, the hypothesis proposing that commercial alliances established during incubation do not increase the likelihood of securing further equity financing (Hypothesis 1b) is also supported. The analysis reveals no significant relationship, confirming prior research emphasizing commercial alliances' limited capacity to effectively signal technological innovation and long-term competitive potential to equity investors (Colombo et al., 2006; Rothaermel & Deeds, 2006). Additionally, the hypothesis predicting that R&D alliances accelerate the timing of subsequent equity financing rounds (Hypothesis 2a) is strongly confirmed by the Weibull Accelerated Failure Time analysis, demonstrating significant acceleration effects. This finding aligns with theoretical expectations regarding the role of R&D alliances in reducing investor uncertainty and speeding up investment decisions (Rothaermel & Thursby, 2005; Baum et al., 2000). Conversely, the hypothesis anticipating that commercial alliances would not accelerate equity financing timing (Hypothesis 2b) is confirmed, as no significant impact was found. This result aligns with existing perspectives suggesting commercial alliances offer limited signalling value within contexts of technological innovation (Colombo et al., 2006; Rothaermel & Deeds, 2006). Regarding patents, although the initial hypothesis proposed that patenting activities during incubation positively influence the likelihood of obtaining additional equity financing (Hypothesis 3), our findings indicate a negative effect. Patents developed during incubation negatively influenced the likelihood of securing additional equity financing. This unexpected outcome contributes to the ongoing debate regarding the role of patents, suggesting that after the initial funding round, informational asymmetries between investors and startups substantially decrease. Consequently, the signalling value of patents diminishes as investor uncertainty regarding the startup's technological capabilities and growth potential is reduced (Cockburn & MacGarvie, 2009; Hsu & Ziedonis, 2013). Finally, the hypothesis predicting that a higher number of ESA BIC partners increases the likelihood of startups forming alliances within the ESA BIC network (Hypothesis 4) is confirmed. The probit regression analysis shows a significant positive effect, emphasizing the critical role of a robust and diverse incubator network in promoting valuable partnerships. This aligns well with previous research demonstrating that denser incubator networks enhance resource availability, foster credibility, and facilitate knowledge spillovers, thereby increasing alliance opportunities for startups (Baum et al., 2000; Ozmel et al., 2013).

7. Conclusions

This study provides valuable insights into how incubator-facilitated alliances and patent activities influence startups' equity financing outcomes within the entrepreneurial ecosystems of ESA BICs. Specifically, our analysis underscores the significant positive impact of R&D alliances on startups' likelihood of securing equity financing and accelerating the timing of funding rounds, highlighting their strategic role as credible signals of startups capabilities. In contrast, commercial alliances, despite their practical market-related benefits, demonstrate minimal influence on both the likelihood and timing of equity financing, indicating their relatively lower perceived innovation value among investors. Interestingly, our findings reveal a negative relationship between patenting activities during incubation and the probability of obtaining subsequent equity financing. This result confirms that the signalling value of patents may diminish as informational asymmetries between startups and investors are progressively reduced. Specifically, as investors gain deeper and more comprehensive knowledge about the startups' technological capabilities, growth trajectory, and market potential, the incremental value provided by patents as signals of quality decreases. Furthermore, the analysis empirically validates the critical role of incubator network breadth, showing that extensive and diverse ESA BIC partner networks substantially promote alliance formation among incubated startups, thereby confirming the proposed "bridging effect" From a practical perspective, these insights highlight the necessity for incubator managers and entrepreneurs to actively foster robust R&D collaborations and strategically expand incubator networks to enhance startups' attractiveness to investors. Despite these valuable contributions, the research has several limitations. Firstly, the exclusive focus on ESA BICs may limit the generalizability of findings to other sectors or incubator environments. Secondly, future research could benefit from expanding the sample size, broadening the geographical coverage, and incorporating additional factors such as alliance quality or investor characteristics. Lastly, potential endogeneity concerns, including reverse causality and omitted variable bias, suggest the need for further research employing longitudinal or experimental methodologies to strengthen causal interpretations. Addressing these limitations offers promising avenues for enhancing our understanding of entrepreneurial ecosystems and the effectiveness of incubators in supporting startup growth.

Ethics and AI Declaration

No ethical clearance was required. AI tools were used for copy editing and proofreading.

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Open Innovation Adoption in Emerging Economies: A Qualitative Exploration of Practices, Enablers and Barriers in the Turkish Ecosystem

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Abstract: This study investigates Open Innovation (OI) adoption in emerging economies, specifically examining how firms strategically leverage external knowledge sources to enhance their innovation capabilities. Employing a qualitative exploratory methodology, the research involves semi-structured, in-depth interviews conducted with innovation managers from four prominent Turkish firms, selected for their recognized innovation capabilities and strategic importance within Türkiye's dynamic innovation ecosystem. The findings highlight a pronounced strategic emphasis on inbound Open Innovation activities, predominantly executed through partnerships with startups, academic institutions, and external technology providers. Among these collaborative forms, structured startup programs emerge as the most frequently utilized and strategically significant, driven by firms' imperative to rapidly respond to evolving market demands and sustain their competitive agility. Key organizational enablers identified include robust senior managerial commitment, well-defined and structured innovation management processes, and a deeply embedded innovation-oriented organizational culture. Conversely, the study identifies critical barriers, such as cultural resistance towards external collaboration (the Not-Invented-Here syndrome), concerns regarding intellectual property management, and significant limitations related to financial and human resources. Theoretically, this research contributes significantly to existing Open Innovation frameworks by explicitly integrating the distinctive institutional, cultural, and resource-based dynamics characterizing emerging economies, aspects that have received limited attention in previous studies. In doing so, it emphasizes the need to refine and expand Open Innovation theories to more accurately reflect contextual influences and strategic adaptations inherent in emerging market settings. This approach enriches the theoretical discourse on innovation management by providing nuanced insights into how context-specific factors uniquely shape Open Innovation processes and practices. From these empirical results, the study concludes that successful Open Innovation adoption within emerging economies requires deliberate managerial efforts to address internal cultural resistance and proactively manage resource constraints, particularly through strategic alignment with agile external partners such as startups and academic institutions. Additionally, fostering an organizational environment characterized by openness, flexibility, and structured innovation processes significantly enhances firms' capacity to exploit external knowledge effectively. Implications for further research include expanding the analysis through comparative studies across multiple emerging economies to better understand cross-contextual dynamics and integrating longitudinal methodologies to explore the evolution of Open Innovation practices over time. Practically, the findings offer clear, actionable recommendations for innovation managers, entrepreneurs, organizational leaders, and policymakers, guiding strategic decision-making, effective partnership management, and resource allocation to foster sustainable competitive advantage and growth in rapidly evolving innovation ecosystems.

Keywords: Open Innovation, Innovation Management, Open Innovation enablers, Open Innovation barriers, Emerging economies, Startup Programs

1. Introduction

In the contemporary global economy, characterized by rapid digital transformation and increasing technological sophistication, organizations are progressively reliant on external knowledge sources to foster innovation and sustain competitive advantage. This approach aligns with the concept of Open Innovation (OI), defined as the strategic use of both internal and external knowledge flows to accelerate innovation processes and enhance market opportunities (Chesbrough, 2003). Differing from traditional, internally-oriented approaches, Open Innovation emphasizes the critical importance of leveraging external knowledge and collaborative interactions to boost innovation performance and capabilities (Chesbrough & Bogers, 2014). The relevance of Open Innovation is well-established both theoretically and practically. From a theoretical standpoint, investigating how organizations manage and leverage external knowledge enriches existing innovation management theories by providing nuanced insights into the dynamics of innovation ecosystems. Practically, successfully adopting Open Innovation strategies enables firms to access critical resources, mitigate development risks, and accelerate

product development cycles, significantly enhancing their competitive positioning in rapidly evolving markets(West & Bogers, 2014). Usually, research on Open Innovation has largely focused on developed markets, predominantly in Europe and North America (Laursen & Salter, 2006; Enkel et al., 2009). However, the investigation of Open Innovation practices in emerging economies provides unique opportunities to enrich theoretical frameworks by addressing distinct institutional arrangements, cultural factors, and resource limitations intrinsic to these contexts (Bogers et al., 2019). Recognizing this opportunity, our study investigates how organizations within an emerging economy engage with Open Innovation, focusing specifically on factors that facilitate or inhibit its successful adoption and management. To address this research objective, we employ a qualitative exploratory approach within Türkiye's emerging innovation ecosystem. Türkiye provides an insightful context due to its distinctive institutional frameworks, dynamic economic trajectory, and strategic geographical position. In-depth interviews were conducted with innovation managers from leading Turkish firms recognized for their innovation capabilities, enabling a thorough exploration of the specific contextual factors affecting Open Innovation practices. From a theoretical standpoint, this research provides a deeper, empirically grounded understanding of Open Innovation dynamics within emerging economies, contexts still relatively underrepresented in the innovation management literature, which has predominantly focused on developed markets. The research explicates the complex interplay among institutional frameworks, cultural influences, and resource constraints intrinsic to emerging market environments. Thus, it enriches existing theoretical frameworks by integrating nuanced insights into how these distinct contextual variables shape organizational behaviors and strategic innovation processes. Practically, the study offers substantial value by identifying precise organizational enablers and barriers to effective Open Innovation adoption, alongside detailed exploration of strategic partnership dynamics. Consequently, managers, innovation practitioners, and policymakers operating in similar emerging contexts benefit from targeted, context-specific recommendations. These actionable insights enable informed strategic planning, effective resource allocation, and proactive management of collaborative innovation processes, ultimately enhancing organizational responsiveness, competitive agility, and sustainable growth trajectories in rapidly evolving markets.

2. Theoretical Background

2.1 Open Innovation Paradigm

Open Innovation has risen prominently as a prominent paradigm within contemporary global markets characterized by heightened technological intricacy and intensified competitive pressures. First conceptualized by Chesbrough (2003), Open Innovation promotes a proactive fusion of internal expertise and external insights, facilitating organizations to effectively harness emergent opportunities and accelerate innovation (Chesbrough & Bogers, 2014). In stark contrast to the traditional Closed Innovation model, which prioritizes strict internal control of innovation processes, Open Innovation underscores collaborative networks, knowledge exchange, and strategic openness to external innovations (West & Bogers, 2014). Traditionally, Closed Innovation dominated strategic innovation practices with its tightly controlled, internally oriented approach to knowledge management and resource allocation (Chesbrough, 2003). However, an array of transformative factors identified by scholars has catalyzed a significant transition toward Open Innovation. Factors such as enhanced talent mobility, wider availability of venture capital funding, rapid technological evolution, and the exponential growth of technology-driven startups have fundamentally altered innovation dynamics (Costello et al., 2007; Braunerhjelm et al., 2020). The increasing complexity of technological landscapes and escalating global competition have further exposed the limitations of exclusively internal R&D processes, compelling firms toward more collaborative and open approaches (Panagopoulos, 2016; Pihlajamaa & Kuusisto, 2017). Open Innovation manifests through three primary mechanisms: inbound (outside-in), outbound (inside-out), and coupled processes. The inbound mechanism entails strategically sourcing external knowledge to reinforce internal innovation capacities, thereby leveraging external technological advancements and market intelligence (West & Bogers, 2014). The outbound mechanism, conversely, involves strategically disseminating internal innovations externally through licensing agreements, spin-offs, and joint ventures, thus optimizing internal assets by tapping into external commercialization pathways (Gassmann & Enkel, 2004). The coupled process synthesizes these two directions, emphasizing strategic collaboration, joint innovation ventures, and dynamic co-creation processes facilitated by broad stakeholder networks (Enkel et al., 2009). Furthermore, extensive scholarly discourse reveals critical enabling factors and notable barriers influencing the successful deployment of Open Innovation practices. Scholars identify pivotal enablers such as a supportive organizational culture emphasizing openness and collaborative dynamics, proactive endorsement and involvement from senior management, robust managerial networks, and organizational behaviours oriented toward innovative initiatives (Naqshbandi,

2016; Lopes & Carvalho, 2018). Conversely, significant obstacles persist, including the pervasive "Not-Invented-Here" (NIH) syndrome, complex challenges in intellectual property rights management, difficulties inherent in coordinating inter-organizational collaborations, and substantial internal resistance toward cultural and organizational change (Chesbrough & Crowther, 2006; Savitskaya et al., 2010; Bigliardi & Galati, 2016)

2.2 Venturing for Innovation

Within this strategic innovation landscape, Corporate Venturing (CV) emerges as a pivotal practice that encompasses deliberate entrepreneurial initiatives by established corporations, whether executed internally or via external partnerships, aimed at integrating cutting-edge technologies, entering nascent markets, or cultivating novel organizational capabilities (Reimsbach & Hauschild, 2012; Prats et al., 2017). Researchers categorize CV activities into internal ventures, where firms leverage in-house resources to spur innovation, and external ventures that include equity investments, strategic acquisitions, collaborative joint ventures, and structured partnerships with diverse external entities such as other corporations, startups, academic institutions, and research organizations (Gutmann, 2019; Siota et al., 2020). Corporate Venture Capital (CVC), a prominent subset within CV, specifically involves minority equity investments targeted at innovative external enterprises. CVC serves as a critical instrument to foster organizational ambidexterity, balancing exploration of emerging opportunities with the exploitation of established capabilities, thereby enhancing strategic agility and competitive advantage (Chesbrough, 2002; Pinkow & Iversen, 2020). Although startups are frequently acknowledged as vital sources of disruptive and agile innovation, Corporate Venturing broadly engages diverse entities including academia, industry competitors, suppliers, and customers to cultivate robust and comprehensive innovation ecosystems (World Economic Forum, 2018; Gnyawali & Park, 2011). Among these actors, startups play a particularly influential role, serving as agile sources of groundbreaking technologies and innovative business models, frequently driving disruptive shifts within established markets and catalysing accelerated innovation processes across diverse sectors (Bogers et al., 2019; World Economic Forum, 2018).

3. Methodology

3.1 Research Objectives

This study aims to offer comprehensive insights into how organizations adopt and manage Open Innovation practices within emerging entrepreneurial ecosystems, particularly within the context of the Turkish innovation landscape. Emerging entrepreneurial ecosystems present distinct characteristics, including unique institutional frameworks, dynamic economic conditions, and varying degrees of resource availability, which can significantly influence innovation management practices (Bogers et al., 2019). Specifically, the research addresses three primary objectives. First, it explores the specific strategies and practices adopted by Turkish firms when engaging in inbound and outbound Open Innovation activities. Second, the study identifies and examines the critical factors enabling or hindering the successful adoption and implementation of Open Innovation within this emerging context. Lastly, the research investigates how Turkish companies establish and manage strategic partnerships, particularly focusing on the dynamics involved in collaborations with diverse stakeholders, including startups, universities, and industry partners. Consequently, this research investigates the following research questions:

- **RQ1:** How do companies in emerging economies engage in inbound and outbound Open Innovation activities, and which strategies characterize their innovation management practices?
- **RQ2:** What are the principal enabling factors and critical barriers influencing the successful adoption and management of Open Innovation in emerging innovation ecosystem?
- **RQ3:** How do firms within emerging innovation ecosystem form, structure, and manage strategic partnerships to support their Open Innovation initiatives?

3.2 Research Design

Given the exploratory nature of this study and the complexity inherent in Open Innovation dynamics, a qualitative exploratory methodology using semi-structured interviews was selected. This qualitative approach allows a deeper understanding of nuanced, context-specific insights and provides flexibility to capture complex organizational phenomena (Kvale & Brinkmann, 2009). Data collection involved conducting comprehensive, semi-structured qualitative interviews with professionals directly involved in innovation activities and responsible for managing Open Innovation practices within their organizations. Interviewees included managers

specializing in innovation development, open innovation and entrepreneurship project management, corporate innovation strategies, and supervisory roles overseeing innovation initiatives. The interviews were structured around open-ended questions designed to elicit rich, detailed narratives about each organization's practices, strategies, and experiences regarding Open Innovation, facilitating diverse perspectives and deep insights. During the selection process, the principles presented by Cyr and Goodman (2024) were followed as the starting point for identifying suitable companies. This strategic selection aimed to ensure comprehensive insights across various sectors influential within the Turkish economy, resulting in the choice of four leading Turkish firms representing diverse industries, including telecommunications, beverage production, aviation, and conglomerate operations. These firms were selected due to their significant market presence, established reputation for innovation, and active engagement with Open Innovation practices. In total, eight in-depth interviews were conducted, ensuring robustness and diversity of insights.

Table 1: Selection of Firms

Company	Business Area	Employees	Revenues (TRY/year)
Firm A	Telecommunications	30,000	100,000,000
Firm B	Beverage	25,000	160,000,000
Firm C	Aviation	40,000	504,000,000
Firm D	Large Conglomerate	60,000	137,000,000

Note: Revenues are expressed in Turkish Lira (TRY) per year

Specifically, the companies included:

- **Firm A (Telecommunications):** A major telecommunications provider known for its extensive fibre optic networks, mobile, internet, and TV services, and proactive engagement in technological innovation.
- **Firm B (Beverage):** A top-ranked player in the beverage industry with a global presence, known for pioneering innovation in consumer goods and sustainable practices.
- **Firm C (Aviation):** A leading airline recognized globally for its extensive flight network and innovative customer service approaches.
- **Firm D (Conglomerate):** A diversified conglomerate with significant operations across sectors such as finance, energy, digital services, and industrials, renowned for strategic innovation initiatives.

The interviews followed a structured yet flexible interview protocol, addressing four major thematic areas: (1) general perceptions and strategic relevance of Open Innovation, (2) detailed practices and strategies in inbound and outbound innovation activities, (3) critical enablers and barriers to effective Open Innovation adoption, and (4) strategies for forming and managing strategic partnerships.

The empirical data collected through semi-structured interviews was analysed using a rigorous thematic analysis approach (Braun & Clarke, 2006). The analysis followed an iterative process, beginning with open coding to identify initial codes from the raw data. These codes were then refined and grouped into broader themes through a process of axial interpretation, enabling the identification of meaningful patterns across interviews. NVivo software supported the coding process by ensuring consistency, transparency, and traceability throughout the analysis. This methodological approach enabled a deep and nuanced understanding of Open Innovation practices across the four analytical dimensions: Activities, Enablers, Barriers, and Strategic Partnerships.

4. Results

The empirical analysis, based on semi-structured interviews with innovation managers from four leading Turkish firms (Firm A - Telecommunications, Firm B - Beverage, Firm C - Aviation, and Firm D - Conglomerate), provides detailed insights into Open Innovation practices within the Turkish entrepreneurial ecosystem. The findings are systematically presented and elaborated according to the four key dimensions: Open Innovation Activities, Enablers, Barriers, and Strategic Partnerships.

4.1 Open Innovation Activities

Firm A actively engages in inbound Open Innovation through extensive strategic collaborations with technology-driven startups, primarily focusing on IoT, AI, and blockchain solutions. The firm utilizes its Corporate Venture Capital (CVC) arm extensively to acquire specific technological knowledge and innovations via minority equity investments. It also values partnerships with academic institutions, engaging in joint research initiatives to access specialized technical expertise. Firm B emphasizes sustainability-driven innovations, strongly engaging with startups and using internal idea platforms to capture employee creativity. The firm also invests significantly in contracted R&D services. Firm C adopts a customer-centric innovation approach, leveraging agile collaborations with startups and placing considerable importance on internal idea platforms and patenting to safeguard proprietary innovations. Firm D, meanwhile, employs a comprehensive strategy, leveraging broad alliances with digital and industrial startups, strategically commercializing innovations through licensing, joint ventures, acquisitions, and minority equity investments facilitated by its CVC units

4.2 OI Enablers

The analysis highlights several critical enablers consistently identified by respondents across the firms. Firm A emphasized the critical role of strong senior management support combined with a well-developed and diverse innovation ecosystem, facilitating effective collaboration and knowledge exchange. Additionally, the firm cited the presence of clear strategic objectives for innovation, helping align efforts across the organization. Firm B underscored its highly innovation-oriented organizational culture and explicit managerial processes designed to encourage innovation and collaborative openness. Moreover, Firm B emphasized employee empowerment and recognition programs that significantly enhanced innovative motivation and creativity. Firm C recognized proactive managerial engagement and a strategically integrated innovation culture as key facilitators driving successful Open Innovation. Furthermore, Firm C highlighted well-structured internal communication channels as instrumental in promoting internal knowledge sharing. Firm D identified significant top management commitment, structured innovation management practices, extensive internal training programs, and agile collaboration platforms as essential enablers, further supported by interactions with governmental bodies, TÜBİTAK (The Scientific and Technological Research Council of Türkiye), investment funds, and entrepreneurial communities.

4.3 OI Barriers

Conversely, respondents consistently acknowledged significant barriers hindering effective Open Innovation implementation. Firm A reported notable constraints stemming from financial resource limitations and organizational resistance to change, which presented substantial challenges in effectively adopting Open Innovation practices. The firm also identified bureaucratic processes and slow decision-making procedures as significant barriers slowing innovation efforts. Firm B specifically highlighted the prevalence of the “Not-Invented-Here” (NIH) syndrome, alongside limitations related to managerial time availability, as primary barriers restricting innovation openness. Moreover, Firm B emphasized difficulties in aligning innovation objectives with operational targets as an additional impediment. Firm C identified internal resistance towards external ideas and insufficient resources, both financial and human, as substantial impediments. Additionally, Firm C pointed to the challenges in managing intellectual property and knowledge-sharing protocols, which occasionally discouraged external collaborations. Firm D similarly emphasized persistent cultural resistance to embracing external innovations and the NIH syndrome as major ongoing challenges impacting their Open Innovation initiatives. Furthermore, Firm D cited limited inter-departmental coordination and inadequate communication strategies as obstacles affecting the smooth execution of Open Innovation processes.

4.4 Strategic Partnerships

Strategic partnerships emerged as crucial elements of Open Innovation across all studied firms, reflecting their strategic priorities and innovation objectives. Firm A predominantly pursued alliances with technology-oriented startups to leverage advanced technological capabilities. Firm B focused strategically on collaborations with startups specializing in consumer goods innovations and maintained robust partnerships with universities to access academic research and insights. Firm C actively sought partnerships with technologically innovative startups and academic institutions to harness complementary knowledge and technology synergies. Firm D leveraged extensive strategic partnerships encompassing startups, academic institutions, and other industry

leaders, thereby enhancing their innovation capacity and market expansion potential through diverse collaborative engagements.

Table 2: Key Results from Firm Interviews

	Firm A	Firm B	Firm C	Firm D
Open Innovation Activities	- Extensive startup collaborations (IoT, AI) - University partnerships (R&D projects)	- Strong collaboration with startups (sustainability tech) - Internal innovation platforms	- Startup collaboration (customer-focused technologies) - Internal idea platforms and patenting	- Broad collaborations with startups (digital and industrial innovations) - Commercialization of internal innovations
Enablers	- Strong management support - Robust innovation ecosystem	- Innovation-friendly organizational culture - Strong managerial processes	- Proactive management involvement - Strategic innovation culture	- Extensive top management backing - Established managerial innovation practices
Barriers	- Limited financial resources - Cultural resistance to change	- NIH syndrome - Time constraints	- Internal resistance to external ideas - Limited funding and resources	- Resistance to cultural shift - NIH syndrome
Strategic Partnerships	- Predominantly technology-driven startups	- Startups focusing on consumer goods innovation - University partnerships	- Partnerships with technology startups and academia	- Strategic alliances with startups, universities, and industrial partners

5. Discussion

The empirical findings from this study significantly enhance the understanding of Open Innovation (OI) practices within emerging economies, particularly through examining Turkish ecosystem. The strategic prioritization of inbound innovation, predominantly via partnerships with startups and academic institutions, aligns closely with established theoretical perspectives highlighting the necessity of integrating external knowledge to effectively navigate technological complexities and maintain competitiveness in dynamic markets (Chesbrough, 2003; West & Bogers, 2014). Notably, firms attribute considerable strategic value to collaborations with startups, reflecting scholarly views of startups as agile, innovative entities capable of delivering disruptive technologies and swiftly adaptable market solutions (Gnyawali & Park, 2011; Bogers et al., 2019). Turkish firms' deliberate engagement with these dynamic collaborators reflects a purposeful strategy, oriented not merely towards technological advancements but also towards increasing responsiveness to rapidly shifting market demands. Furthermore, active collaborations with academic institutions highlight firms' recognition of advanced research and specialized expertise as strategic complements to their internal innovation efforts, effectively bridging internal knowledge gaps and supporting sophisticated innovation trajectories (Costello et al., 2007). Internally, robust senior management commitment, structured innovation processes, and a culture strongly focused on innovation emerged as essential organizational enablers. These insights corroborate established academic arguments emphasizing structured internal processes and proactive managerial strategies as critical to effectively absorbing and exploiting external knowledge (Naqshbandi, 2016; Lopes & Carvalho, 2018). Firms' strategic alignment of internal communication and innovation initiatives further underscores theoretical assertions about organizational readiness as a pivotal determinant for successful external knowledge integration (Bigliardi & Galati, 2016). Conversely, the study identifies significant barriers, notably cultural resistance epitomized by the Not-Invented-Here (NIH) syndrome, reinforcing existing literature that stresses the critical importance of fostering cultural openness within organizations (Chesbrough & Crowther, 2006). Additionally, resource

constraints such as limited managerial bandwidth and financial limitations complicate Open Innovation implementation, aligning with academic discussions regarding strategic resource allocation and managerial prioritization as necessary solutions (Savitskaya et al., 2010). Lastly, firms' strategic diversification in external partnerships—spanning startups, academia, and industry peers—demonstrates a comprehensive understanding of external networks as essential innovation drivers, consistent with scholarly perspectives advocating wide-ranging external engagements to sustain innovation performance (Gnyawali & Park, 2011).

6. Conclusions and Limitations

This research significantly enhances the theoretical and empirical understanding of Open Innovation practices in emerging economies, particularly by providing a detailed examination of how Turkish firms strategically integrate external knowledge into their innovation processes. The study offers precise insights into the dynamics of innovation activities, highlighting startups and academic institutions as crucial external innovation partners. Specifically, consistent with prior literature (Bogers et al., 2019; Gnyawali & Park, 2011), our findings confirm the strategic relevance of startups as agile providers of innovative technological solutions, enabling firms to swiftly respond to dynamic competitive pressures. Similarly, in alignment with earlier studies (Costello et al., 2007), academic institutions emerge as pivotal sources of specialized knowledge and advanced research, bridging critical internal knowledge gaps and effectively supporting firms' long-term innovation trajectories.

Moreover, this research expands upon existing scholarship (Naqshbandi, 2016; Lopes & Carvalho, 2018) by explicitly identifying and empirically validating critical organizational enablers for effective Open Innovation management. These include robust managerial commitment, clearly defined innovation processes, and a strongly embedded organizational culture oriented towards openness and innovation. Conversely, in accordance with previous findings (Chesbrough & Crowther, 2006; Savitskaya et al., 2010), significant barriers such as the pervasive Not-Invented-Here syndrome, financial and managerial resource constraints, and internal cultural resistance have been identified and empirically substantiated as challenges that firms must strategically navigate to leverage the full potential of Open Innovation.

An important observation emerging from our study, however, highlights distinctive differences from earlier research focused predominantly on developed markets. Notably, firms in Türkiye demonstrated heightened reliance on structured partnerships with startups to overcome resource constraints, reflecting specific adaptation strategies uniquely suited to emerging-market contexts. From our perspective, this strategic dependency underscores the critical necessity for firms in similar institutional settings to actively foster flexible, responsive collaboration networks, particularly emphasizing startup ecosystems as integral innovation drivers.

Practically, the study offers significant contributions through precise, actionable insights and clear managerial recommendations. For innovation managers and organizational leaders, these results underscore the necessity to proactively cultivate an innovation-supportive organizational culture, systematically engage senior management in innovation processes, and develop structured practices for external innovation collaboration. For entrepreneurs and startups, our findings highlight clear opportunities to strategically position themselves as preferred innovation partners by aligning closely with large firms' innovation needs. For policymakers, the study provides valuable recommendations on fostering conducive regulatory frameworks, facilitating innovation collaboration networks, and addressing critical resource gaps through targeted financial and managerial support measures, thus enhancing innovation capabilities across the broader innovation ecosystem.

Despite these theoretical and practical contributions, several limitations merit consideration. The qualitative exploratory design, while providing deep contextual understanding, inherently restricts the generalizability of the findings. Future research employing larger, diversified sample sizes and integrating quantitative or mixed-method approaches would significantly enhance empirical validity and applicability across contexts. Moreover, the study's geographic concentration on Türkiye limits direct applicability to other emerging economies. Comparative studies across multiple emerging market contexts could further enrich understanding by systematically capturing cross-national and cross-cultural variations in Open Innovation practices. Finally, the cross-sectional nature of this study restricts a comprehensive understanding of evolving Open Innovation dynamics. Longitudinal research designs would provide valuable insights into long-term strategic implications and the evolution of Open Innovation processes and partnerships over time.

Ethics and AI Declaration

This research is based on qualitative data collected through semi-structured interviews. All participants were informed about the purpose of the study, and their participation was entirely voluntary. Data were anonymized to ensure the privacy and confidentiality of respondents. According to the institutional guidelines and national regulations applicable at the time of data collection, formal ethical clearance was not required for this type of research. The study was conducted in accordance with the ethical principles and followed best practices for responsible research involving human participants. AI tools were used for copy editing and proof reading.

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Gendering, Biology, and Stereotypes in Entrepreneurship Training

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Abstract: This conceptual paper interrogates the gendered assumptions underpinning perceptions of women's capacity for economic agency. It challenges biologically determinist and historically entrenched narratives that continue to shape entrepreneurship discourse. It unravels the persistent stereotypes, rooted in outdated constructions of women's domestic seclusion, workforce needs, and gendered labour divisions, that have relegated women to the margins of entrepreneurship and innovation. It critiques how postfeminist and neoliberal feminist narratives obscure the socio-historical processes through which these assumptions have been normalised. Through its critical reconceptualisation of gender, biology, and economic agency, it highlights how normative legacies continue to shape attitudes to gender and entrepreneurship and innovation. It argues for the integration of structural and historical analysis into entrepreneurship education to unsettle essentialist logics and equip students with the conceptual tools to examine how entrepreneurial subjectivities are institutionally and discursively constituted. It proposes a shift toward reflexive pedagogical approaches that encourage students to critically reflect on how assumptions, stereotypes, and practices are embedded in understandings of economic agency and gender. Its theoretical contribution is its advance of the imperative of analytical engagement with the socio-historical formation of institutional frameworks and their normative legacies to unpack gendered assumptions that continue to undermine women's entrepreneurial and innovation capacities.

Keywords: Entrepreneurship Education, Gender and Entrepreneurship, Mate Guarding Theory, Neoliberal Feminism, Postfeminism, Women's Economic Agency.

1. Introduction

This conceptual paper explores the historical, cultural, and socio-economic foundations that have shaped perceptions of women's capacity for economic agency, arguing that understanding these roots is essential for addressing persistent gender disparities in entrepreneurial ecosystems. By critically investigating the origins of the stereotypes and narratives that continue to influence how women's economic roles are evaluated, this study offers a theoretical basis for advancing gender equity. Embedding gender awareness into entrepreneurship education will serve as a strategic intervention to challenge entrenched biases and promote more inclusive entrepreneurial practices. In doing so, education becomes not only a vehicle for skills development but a means of transforming perceptions and opening equitable opportunities.

Despite the proliferation of university programmes designed to foster entrepreneurial competencies, a critical gap remains in addressing the persistent influence of gendered perceptions within the entrepreneurial ecosystem. Deeply rooted stereotypes continue to position men as the default entrepreneurs and women as peripheral or less capable, subtly shaping how entrepreneurship is both practised and understood. Associated narratives reinforce structural inequities and undermine inclusivity in entrepreneurship. As Ahl (2006) demonstrates, dominant discourses are sustained through cultural and institutional norms that perpetuate assumptions about gender and entrepreneurial competence. These perceptions typically remain unchallenged in educational spaces, necessitating the introduction of gender awareness components that foster critical engagement with the socio-cultural dimensions of entrepreneurship and innovation.

2. The Historical Exclusion of Women From Economic Life

Biases against women's entrepreneurial and innovation capabilities stem from historical practices, principally the seclusion of women to ensure paternity certainty, the demands of frequent pregnancies prior to the availability of effective birth control, and the emphasis on upper body strength in labour-intensive sectors such as agriculture, mining, construction, transport, and the military. These historical issues created rigid gender roles that have given rise to an essentialist view of gender meaning a belief that gender is determined by biological traits that are innate and universal, and that men and women have distinct qualities that are rooted in their biological sex.

However, the advent of mechanization, automation, and digitalization has significantly altered the demands placed on the labour force, while advances in birth control have reduced the number of children women typically bear. Despite these transformative changes, the gender roles shaped by historical labour requirements and family dynamics persist and are still typically upheld as "natural." These enduring perceptions have contributed to prejudices that question women's capabilities as economic agents most especially in innovation and

entrepreneurship. By examining how intersections of gender and work emerge in specific historical, cultural, and geopolitical contexts, students can gain a deeper understanding of how societal and cultural norms are generated and perpetuated. Analysing how these norms evolve in response to changing economic, political, and social realities can equip students with the tools to critically assess and disrupt the gender biases that persist within entrepreneurship.

3. Mate Guarding: The Roots of Economic Exclusion

The first question to address, and the one that I will focus on given the limitations of a single paper, is the origins of women's exclusion from the economic sphere. Why have women been secluded within the domestic domain and systemically barred from productive labour? The source of their domestic seclusion lies in the practice of mate guarding. This necessitates some consideration of the biological basis for gendered roles, the primacy of the reproductive instinct, and the very different roles of men and women in reproduction. The enormous asymmetry in reproductive biology between men and women has had profound implications for evolutionary strategies and social structures (Buss, 2002). The salient issue is that of paternity uncertainty by which is meant that, men, unlike women, cannot be biologically certain of their genetic relationship to children. A primary response to paternity uncertainty, in contrast to maternity certainty, was to control a female partner's access to other males and attempts to ensure female sexual fidelity. This response to the uncertainty around male reproduction and men's fear of investing in another man's child spawned the practice of keeping their mates secluded, known as mate guarding, to preserve reproductive exclusivity. The construct of female honour, generated as a societal norm to support mate guarding, serves to increase woman's sexual fidelity to ensure their own social approbation and encourages women to maintain their seclusion (Kupfer and Gul, 2023). Similarly, the socio-legal category of illegitimacy functions as a mechanism to reinforce patriarchal lineage through the imperative of paternity certainty, to regulate female sexuality by enforcing norms of chastity and marital fidelity, and to uphold heteronormative family structures by positioning the nuclear family as both morally superior and economically legitimate (Smart and Smart, 1978). Social expectations that frame women as biologically predisposed to find existential fulfilment in reproductive work have evolved around emerged from these socio-legal structures (Friedan, 2013).

In the contemporary world, the practice of mate guarding is vividly exemplified in the context of Afghanistan, where, under Taliban rule, women have been forced into almost total domestic seclusion through legislative restrictions. They are not permitted to attend secondary school or university, are largely banned from the workforce, barred from public spaces such as parks, and must wear full body covering in public. However, it is important to recognize that comparable restrictions were prevalent historically in European societies where marked constraints on women were common even in the 20th century and beyond. In the UK, for example, the law of coverture meant that a woman's legal identity was subsumed under her husband's on her marriage, and she could not own property independently. Her husband had full control of her assets and income, had legal authority over her body, and could not be charged with raping her until 1991. The legal structures of coverture were not dismantled until the 20th century. It was only in 1975 that women in the UK were allowed to open a bank account in their own name and, even then, needed the signature of their father if they were not married. Women were not permitted to work in the London Stock Exchange until 1973. It was not until 1975 that the UK Sex Discrimination Act prohibited discrimination based on sex in employment and education. Only as late as 2010 was legal protection for women in the workplace and public arena reinforced with the Equality Act which consolidated various anti-discrimination measures. The underlying rationale for such legal frameworks was grounded in a patriarchal logic aimed at preserving women's structural economic subordination and guaranteeing paternity certainty, thereby ensuring that male investment was devoted exclusively to their biological offspring.

These attempts to manipulate the implications of the biological imbalance between maternity certainty versus paternity uncertainty have underpinned social narratives that naturalize gender divisions of labour, justify different social expectations, and shape institutional arrangements around economic activity.

4. Patriarchal Taboos and Ideological Silencing

Despite the magnitude of mate guarding practices and their multifaceted consequences, the topic has been only moderately addressed in the academic literature. The most well-known scholar in the area of mate guarding is the American evolutionary psychologist David Buss (e.g., Buss, 2002) whose work has inspired research in various issues related to mate guarding (e.g., Haselton and Gangestad, 2006; Starratt and Shackelford, 2023).

Interestingly, for animals there is a broad literature on how males of different species act to safeguard their investment in offspring (e.g., Elias et al., 2008; Kokko and Morrell, 2005). This limited attention to the evolutionary practice of human mate guarding begs the question as to why its historical and biological origins have been ignored. A plausible interpretation is that this silence functions in service of patriarchal ideology by maintaining the taboo surrounding the marginalization or invisibility of the male role in biological reproduction.

Recent developments relating to feminist thought have served to perpetuate this silence. Postfeminism maintains a cultural and ideological position that insists **that feminist goals** have already been achieved. This stance reconfigures feminist constructs and ignores structural inequalities, framing gender issues as personal choices rather than political struggles, thus circumventing attention to genderist practices. Neoliberal feminism aligns itself with market-based empowerment and highlights women's success through economic engagement rather than structural change or awareness of the historical trajectories that led to women's disempowerment. As Fraser (2013) and Rottenberg (2018) have demonstrated, neoliberal feminism has depoliticized feminist goals by recasting empowerment as a matter of adapting to existing economic systems rather than challenging the systemic inequalities and power hierarchies that continue to sustain and validate gendered stereotypes, practices, and experiences. Postfeminist and neoliberal feminist perspectives celebrate individual progress, and ruinously neglect the enduring influence of historical structures, such as mate guarding and women's exclusion from productive work, that have shaped societal understandings of women's roles and curtailed their exercise of economic agency. This omission contributes to perpetuating an incomplete and overly optimistic narrative that fails to address the systemic and cultural barriers still facing women, particularly in the realms of entrepreneurship and innovation and productive work in general.

5. The Impact of Mate Guarding on Women's Economic Agency

With such legal and societal modalities highly salient in most geopolitical settings in the past, women were effectively removed from the economic sphere except in the most menial of roles, in women-only type activities such as pre-industrial weaving, and largely through economic necessity. Such a socio-historical context shaped women into subjects with limited economic agency and this landscape has only begun to change in recent decades.

Buss (2002) has demonstrated how mate guarding has historically contributed to limiting woman's visibility and participation in public and economic life. Its centrality has further manifested in the vast array of legal constraints and structural norms designed to control women's mobility and access to financial independence (Starratt and Shackelford, 2023) and thereby increase their reliance on men. Smuts (1995) has discussed in detail how women have been framed as reproductive assets within patriarchal systems and this has operated as a mechanism to undermine their roles as economic agents. While legislative developments have altered institutional realities for women as economic agents to some degree, the ideological remnants of this practice persist, contributing to understandings of women as primarily domestic beings. This materially constrains women's economic agency, protecting gender divisions of labour and producing narratives that belittle women's capacity for economic participation (Kaufmann, 2022), most especially in creative areas such as entrepreneurship and innovation. Such narratives and discursive modes reproduce gendered subjectivities and sustain pejorative tropes that undermine women's perceived capacity for entrepreneurship and innovation (Ahl, 2006). Without addressing the origins of how women's economic agency was constrained through their being barred from the economic activity, education, and training that equip an individual for greater innovation and entrepreneurship, these stereotypes will continue to exert influence.

6. Integrating Gender Awareness Into Entrepreneurship Education

I now present some suggestions for a course structure aimed to equip students with a nuanced understanding of the historical roots of gender biases and provide tools to actively challenge and dismantle these barriers in entrepreneurial and innovation ecosystems.

Historical labour divisions and gender roles: This component would focus on the evolution of labour divisions and how these shaped historical gender roles such as the requirement of upper body strength in agriculture and industry. It would overview the transformation of the labour market due to technological advances and how these have changed the demands of the labour force rendering many former gender distinctions obsolete.

Family structures and reproductive control: This module would address gender, biology, and stereotypes through examining biological facts and myths and critically analysing how biological determinism has generated

stereotypes about women and their economic agency. Importantly, it would examine the impact of family structures, articulating how the domestic seclusion of women and emphasis on paternity certainty and mate guarding contributed to perceptions of women's roles and capabilities. It would discuss the ideological biases that account for why these outdated gender roles are still perceived as natural or biologically determined.

Cultural norm formation: Another valuable component of such a course would be an analysis of how cultural and social norms are formed through historical and geopolitical realities. Exploring how societal norms are constructed, perpetuated, and internalized through socialization processes and media even after the social realities that gave rise to them have transformed would generate greater understanding of the legacy of norms and values devoid of contemporary relevance.

Contemporary stereotypes and representation: Next, the course could identify current stereotypes that undermine perceptions of women's capacities in entrepreneurship and innovation. An analysis of the discursive encapsulations of these stereotypes and their presentation in media would reveal the pervasiveness they continue to have (Poutanen et al., 2016). This could also include a scrutiny of how women are underrepresented in entrepreneurship and innovation and also of gender disparities in funding and leadership opportunities.

Transformative frameworks for change: The course could continue with a focus on transformative frameworks for change which would include critical consciousness and bias awareness, thus helping students to recognize their own biases and those that they witness in society. This component would also explore how value systems can alter over time when the conditions that created them have changed and of how, by contrast, certain values can resist such change despite shifting conditions.

Case studies and intersectionality: The course could conclude with exemplifying best practices and case studies of women who navigate systemic barriers and stereotypes to achieve success in their entrepreneurial and innovation endeavours. This component could also address intersectionality to explore how socio-economic class, ethnicity, educational background, and other social factors intersect with gender to shape entrepreneurial experiences.

7. Conclusion

This paper underscores the importance of consciousness-raising efforts that interrogate the historical roots of gendered norms as a vital step in dismantling persistent demeaning stereotypes of women as entrepreneurs and innovators. By tracing the historical roots of these biases, students and educators can gain a deeper understanding of how these norms have evolved and remain deeply embedded in contemporary perceptions of women's capabilities in entrepreneurship and innovation. By bridging historical awareness with actionable insights, this paper advocates for a transformative educational approach that equips future entrepreneurs and innovators to contribute to more inclusive and equitable economic ecosystems. It would also lay the groundwork for broader social equity by directly confronting the historical and structural conditions that have systematically disadvantaged women within the economic domain.

Ethics Declaration

No ethical clearance was required for this conceptual paper.

AI Declaration

AI tools were not used in the development of this paper.

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Entrepreneurship and Innovation in Final-year Social Area Students' Intervention Initiatives Intentions

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Abstract: Education for social entrepreneurship in higher education is an area in consolidation. However, social innovation is a labour market requirement to which students in the social field should not be oblivious. We sought to explore the interests in the field of social entrepreneurship - type of proposal, target audience, theme/social issue to be solved - of 94 final year students of a Social Education degree, 96% of whom were female. An *ad hoc* questionnaire was used. In analysing the content of the answers, the intention to develop a social project after graduation or to create a social support product/material prevailed, 32% and 31% respectively. Less expressive were the intention to innovate an existing organisation or to create a company/organisation, 17% and 16%, in that order - the latter perhaps due to the greater risk it entails. In terms of the proposals target population, there was a variety of groups covered (to be expected in this social area), with children and young people/school community and the elderly standing out (27% and 26%), as well as people with disabilities (19%) and children and young people at risk (15%). Other groups in vulnerable situations, such as the unemployed, immigrants and refugees, prisoners, informal carers and the homeless (between 2 and 6%) were mentioned to a lesser extent. Ideas included, above all, the implementation of skills training programmes (33%). This was followed by the distribution of essential goods/access to services (19%), artistic activities to promote inclusion (17%) and support services at home (14%). Other possibilities included leisure initiatives, intergenerational activities, support to promote employability, infoinclusion actions and the development of support materials (between 3 and 8%). Despite the relevance of the proposals, the majority (69%) did not anticipate any source of funding (public funds or corporate/organisational social responsibility). These students training should provide for the development of entrepreneurial skills centred on creativity and social innovation and, in a structured way, knowledge of financing options and business plans design using management skills, which are equally fundamental in the social area.

Keywords: Entrepreneurship; Innovation; Social Intervention; Students; Higher Education

1. Introduction

Currently, the responsibility of Higher Education Institutions (HEI) goes beyond the concern with graduation and certification of graduates, committing themselves to the overall training of students, facilitating their preparation for the growing demands of the job market (Fernandes and Amante, 2022). A set of transferable skills (soft skills), which are structural for career development, are important here, as they make it easier to adapt to the opportunities and challenges of the world of work, which is increasingly demanding and undergoing permanent and accelerated change (Qizi, 2020). The personal and social development of students and graduates must therefore be promoted, so that they are critical citizens and can seek their own personal and professional fulfilment (Monteiro, Gonçalves and Santos, 2019).

In this context, it is essential to include curricular units on entrepreneurship and innovation in study plans, to create support services for career preparation at HEI and to implement co-creation projects joint with community organizations, along with other initiatives that enhance the development of training actions that complement the formal curriculum and offer opportunities for students to get involved in innovative actions, emphasising research in the area (Arulmani et al, 2014; Fernandes, 2013; Fernandes and Amante, 2022; Orteu, 2017).

The adaptive transition of students to the job market should include the concerns of HEI leaders, as those of the researchers and teachers. Therefore, updating training in pedagogical practices centred on the student is the biggest teachers' challenge. These innovative practices have proved promising in some HEI, with benefits in students' transition job market skills (Carvalho et al, 2022; Fernandes and Amante, 2022). Success in promoting these soft skills, essential in a globally competitive world of work, has been related to the involvement of academia in projects with organizations and community (Fernandes and Amante, 2022; Mangas, 2020).

In Portugal, self-employment was at the forefront of employment dynamics in pre-pandemic, with 57% of created jobs between 2018 and 2019 (INE, 2025). The global daily life great impact of public health crisis (Covid-19 pandemic) at 2020-21, was even more unpredictable on the world of work (Link to Leaders, 2020): i) working methods have changed, with increasing use of technology (remote work), and the economy was strongly shaken; ii) citizens and companies/organizations were more resilient, and multiple opportunities also arose, emerging many innovative projects in all areas, including social ones. In 2024, a new maximum of employed population in Portugal was reached, due to the increase of self-employed workers (INE, 2025).

A new political commitment is needed to promote entrepreneurship, considering what is happening in Portugal and around the world (as a result of the digital transformation of the labour market, the financial crisis, the Covid-19 pandemic, conflicts between countries), in order to sustain competitive and innovative advantages that promote inclusion and social cohesion (Moreira, 2023).

In fact, entrepreneurship has growing of interest, not only in economics, but also in the humanities and social sciences (Baggio and Baggio, 2014). Also, within organizations, human resources have progressively become a more important source of richness (Noutel et al, 2021).

The entrepreneurship and innovation as content in training programs, a priority for HEI, allows for the development of essential skills for creating business ideas and self-employment, but also soft employability skills (entrepreneurial attitude, creativity, teamwork, communication, among others). So, is imperative to consolidate the education for social entrepreneurship in higher education (Filipova et al, 2024; Mónico, 2021; Ndou, 2021), emphasizing the active methodologies role (e.g. analysis of social issues/cases) which greatly promote empathy and proactivity (Pischetola and Martins, 2021). Innovation is a job market requirement, crossing all training areas (Fernandes et al, 2021; von Thienen, Royalty and Meinel, 2017), especially social innovation, such a particular challenge for students in the social field (Roslan, 2020).

In this paper, we sought to explore the social entrepreneurship interests of final year students at a Social Education degree.

2. Methodology

2.1 Participants

A quantitative exploratory study was developed, with 94 finalists of a degree in Social Education, mostly female (96%), which in fact translates the reality of this professional area.

2.2 Instruments and Procedure

An *ad hoc* questionnaire was used, filled out in the context of class, and the ethical assumptions that include informed consent were guaranteed. In addition to the sign of the informed consents by the participants, to ensure the confidentiality and protection of the personal data obtained, the researchers were available to clarify any doubts following the reading of the document or later. In relation to the data, a content analysis of the emerging categories was carried out.

3. Presentation and Discussion of the Results

The content analysis (Figure 1) showed the intention to develop a social project after graduation or to create a social support product/material prevailed, 32% and 31% respectively. Less expressive were the intention to innovate an existing organisation (17%) or to create a company/organisation (16%), the latter perhaps due to the greater risk.

Participants prefer to invest in something from scratch (namely a project/product/material - 63%), rather than innovate/transform something that already exists, perhaps associated with their greater decision-making/intervention power. However, this willingness to invest in something new is not an intention to create a company/organization, possibly due to greater economic and even psychological demands/risks. Policy education and risk management should include how to assess and mitigate the potential negative impacts of business activities (Al Issa, Thai and Nguyen, 2024).

In another study in Portugal, a high proportion of the university students surveyed (76%) considered entrepreneurship as an alternative to employment. However, most of them (82%) were hesitant about the

viability of an entrepreneurial activity in the current context, considering that all situations should be carefully considered (Moreira, 2023).

There are multiple factors to consider, discussed in the literature (e.g. Moreira, 2023; Xanthopoulou and Sahinidis, 2024), which influence higher education students' decisions to become self-employed or start a business. These include contextual factors, such as the economic and socio-political environment; motivational factors, such as needs, individual characteristics and personality, ranging from self-confidence, risk-taking and autonomy; and factors associated with personal history, such as the impact of education, the influence of family and peers.

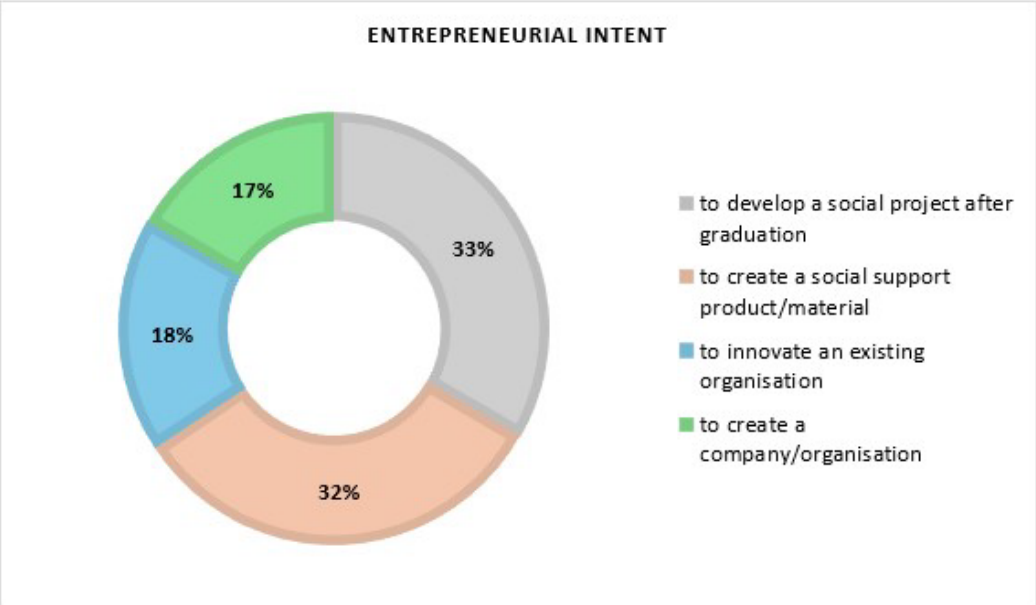


Figure 1: Percentages related to entrepreneurial intent

About the proposals target population (Figure 2), there were many groups covered (as expected in this social area), with children and young people/school community and the elderly standing out (27% and 26%), as well as people with disabilities (19%) and children and young people at risk (15%). Other groups in vulnerable situations, such as the unemployed, immigrants and refugees, prisoners, informal carers and the homeless were mentioned to a lesser extent (between 2 and 6%).

The choice of the school community (in first place, but only 1% away from the following) may be related to the greater affirmation of the role of the social educator in the school to respond to social transformations, with new roles associated with it (Martins, 2020; Prada, Novo and Lima, 2025).

Concerning the elderly, perhaps the 51.7% (136.4% to 188.1%) of increasing aging rate on the Portuguese population from 2013 to 2023 (PORDATA, 2025) influenced the perception that it is a privileged employment area. In fact, it coincides with the gap in terms of social services for this population, since, according to the *Carta Social*, in 2022, the average coverage rate of the main responses in mainland Portugal was limited to 11.6%, with a decrease starting in 2021 (GEP, 2024).

Reinforcing this idea is the following group (people with disabilities), in which the institutions are also insufficient, with 4.2% of coverage rate in mainland Portugal in 2022, according to the same source.

Regarding children/young people at risk, the interest may be related to the issues mentioned in relation to the school community, of which they are also a part, and with whom the role of the social educator also stands out.

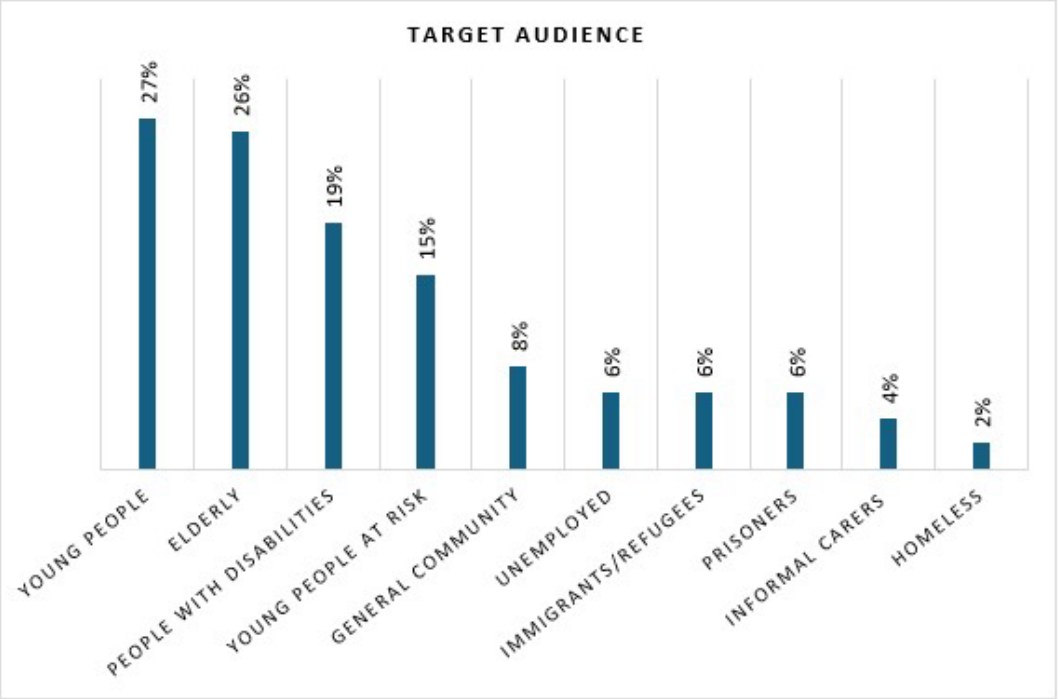


Figure 2: Percentage of entrepreneurial ideas by target audience

The type of project ideas (Figure 3) includes, above all, the implementation of skills training programmes (33%). This is followed by the distribution of essential goods/access to services (19%), inclusion by artistic activities (17%) and support services at home (14%). Other possibilities include leisure initiatives, intergenerational activities, support to promote employability, infoinclusion actions and the development of support materials (between 3 and 8%).

Unsurprisingly, the results are associated above all with the most targeted populations in the proposals (children and young people, the elderly, and people with disabilities), and those in the most fragile situations (particularly the elderly and people with disabilities), closely followed by children and young people at risk.

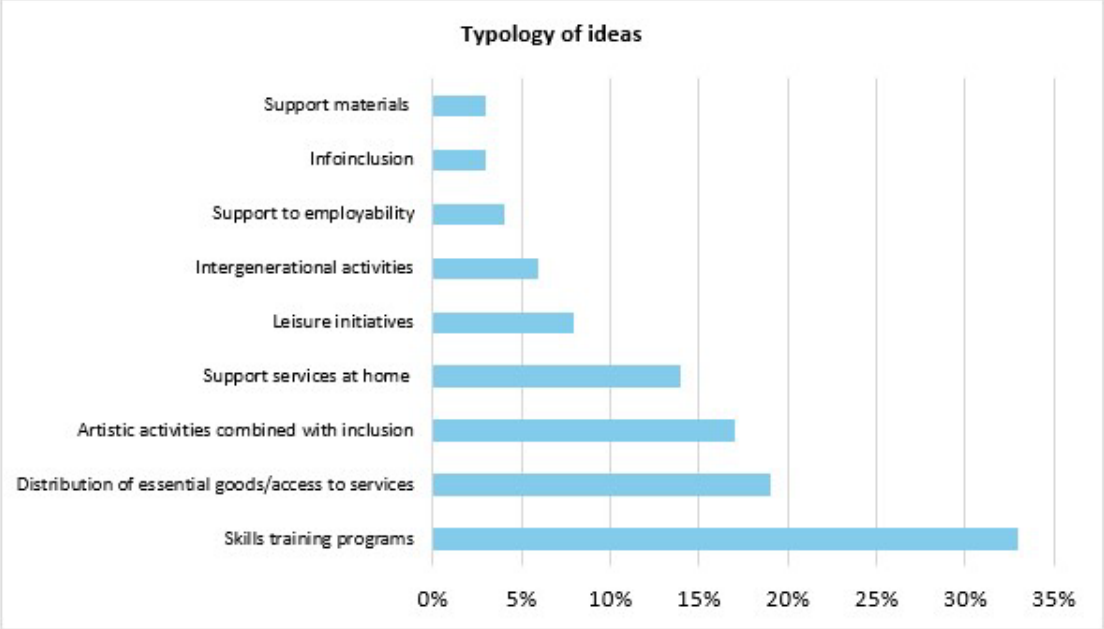


Figure 3: Percentage of ideas typology

Despite the relevance of the proposals, the majority (69%) do not anticipate any source of funding (public funds or corporate/organisational social responsibility), perhaps related to a very young population of participants

(due to the reduction in the number of years of the post-Bologna degree), eager for ideas and projects, with little experience to anticipate needs/resources, in which emotional inferences and training can be relevant.

It is also interesting to note that research into entrepreneurial intention has focused on the area of administration - 32.6% of the world's publications - also focusing on business management. As for the social sciences, the figure drops to 21.8%, still a far cry from the lower percentage of 2% in arts and humanities. At a country level, Malaysia has the largest number of publications on the factors that influence university students' entrepreneurial intentions, which can be justified by the strategic emphasis on entrepreneurship as a catalyst for economic development, entrepreneurship education in the academic system, funding and support for research, etc. (Xanthopoulou and Sahinidis, 2024).

In Portugal, the students with a high orientation towards entrepreneurship are more represented in “engineering, technology and architecture”, “law, management and administration”, “tourism, sports and leisure” courses, compared to “social sciences, humanities and education” and “exact sciences, health and environment”, which also attests that entrepreneurship in higher education is centred on courses in which men predominate (Moreira, 2023). Therefore, once again, these are not isolated issues, but distinct factors influencing entrepreneurial intention, which should be studied and possible gaps overcome.

4. Conclusion

The results leave us optimistic about the development of entrepreneurial skills in students in the social field, while at the same time highlight the need for them to be enhanced and worked on. The importance of HEI in fulfilling this role calls for curricular requirements that include experiences that facilitate the development of entrepreneurial skills centred on creativity and social innovation and, in a structured way, knowledge of financing options and business plans design using management skills, which are equally fundamental in the social area. More than the areas in which young students intend to invest, it is above all important at this stage to understand their desire to create their own jobs, with a wealth of ideas, and to take advantage of this intrinsic motivation to work on skills that will enable them to be successful. This is even more important as employment figures worsen, but also as social vulnerability increases because of the successive crises we have been going through due to the Covid-19 pandemic, the Russia-Ukraine war, and the economic challenges arising from recent North American policies.

One limitation of the study is the dimension of the sample, which could be extended. The comparison of results could also be more robust, considering that the literature focuses on entrepreneurship in higher education students in general, and not so much in social courses. It may therefore be pertinent to carry out future research with students in that area from different universities and with longitudinal approaches, allowing for a more in-depth assessment of the impact of addressing these contents/skills development on graduates' career paths. The factors that interfere with this process should also be analysed.

Acknowledgements

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Ethics Declaration

The study was conducted in accordance with the Declaration of Helsinki. The informed consent was guaranteed from the participants.

AI Declaration

No AI tools were used in the development of the paper.

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Data-Driven AI in Social Care Wales: Identifying Gaps and Opportunities

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Abstract: This study presents a narrative synthesis of the available evidence of the role of data-driven artificial intelligence (AI) in shaping social care in Wales, UK. The increasing integration of AI technologies across various sectors has raised critical questions about their potential impact on social care services, particularly concerning decision-making processes, ethical considerations, and the overall quality of care provided to vulnerable populations. While AI has been widely adopted in healthcare and other industries, its application within social care remains relatively underexplored with limited empirical evidence regarding its effectiveness in supporting professionals, caregivers, and service users, making it imperative to establish a solid evidence base to guide future implementation and policy decisions. Data collection involved comprehensive searches across multiple databases, including SCOPUS, PubMed, Social Care Online, and Google Scholar, alongside grey literature to ensure a thorough review of existing studies. The search strategy utilised specific keywords related to 'Artificial Intelligence' or 'AI', 'Social Care', and other relevant terms such as 'data-driven' or 'data driven', 'old age', 'caregivers', and 'service users', combined primarily using the Boolean operator 'AND,' with selective use of 'OR' to refine results, particularly around the topic of 'old age.' This focused approach yielded 642 studies, with 148 addressing AI in Social Care. Following rigorous screening, 22 studies were ultimately included, revealing substantial variability in quality, settings, and outcomes. Majority of studies focused on older people in care settings. While some studies demonstrated that AI could enhance efficiency, personalise care, and ease caregiver burdens, others highlighted significant ethical and practical obstacles. Key concerns included data privacy and security, algorithm biases, the digital divide, and a lack of trust and understanding of emerging technologies among older adults. Findings suggest AI has the potential to revolutionise social care, improving outcomes for service users, caregivers, and professionals, and highlight the need for evidence-based policymaking to integrate AI into social care and focus on long-term studies and interdisciplinary collaboration to address ethical and accessibility issues in the future.

Keywords: Artificial Intelligence, Social Care, Innovation, Care Delivery

1. Introduction

This paper analyses the literature that discusses the role of data-driven artificial intelligence in shaping up the future of Social Care in Wales, United Kingdom, and attempts to identify gaps, challenges and opportunities that can help the sector overcome its challenges in the area of innovation which is critical in improving care and support, and increasing public confidence in care (Social Care Wales, 2022).

Artificial intelligence (AI) and data-driven technologies offer considerable potential within the social care sector due to their ability to rapidly analyse complex datasets and generate insights that can enhance service delivery and individual outcomes. Their adoption may address pressing sectoral challenges, including cost reduction through extended independent living, the delivery of remote services to support self-management of chronic conditions, and decreased reliance on domiciliary care. Furthermore, these technologies can facilitate closer integration between health and social care systems and enable more personalised, preventive interventions through the use of data analytics and algorithmic decision-making (Wright, 2020).

The UK social care sector is currently facing a critical shortage of care professionals, a challenge that has prompted increasing calls for the adoption of innovative technologies to enhance service delivery and sustainability (Ravalier et al., 2019). In this context, artificial intelligence (AI) and data-driven technologies are frequently cited as potential enablers of transformation, particularly in improving efficiency, supporting decision-making, and delivering more personalised care. Targeted investment, such as funding from the Welsh Government, and collaboration between Social Care Wales and medical technology (MedTech) firms may play a pivotal role in fostering innovation, especially in rural areas where access to services remains a persistent challenge. Such efforts can contribute to the development of more resilient, community-based models of health and social care (Best & Myers, 2021).

Despite this potential, recent engagement by the NHSX AI Lab with technology providers and care organisations has revealed that the social care sector remains underdeveloped in its application of AI, likely due to its fragmented provider landscape and the continued reliance on manual data collection processes (NHS, 2024).

Given these gaps, there is a pressing need to assess the current state of evidence surrounding AI applications in social care.

This literature-informed narrative synthesis explores the early application of data-driven AI technologies in the social care sector, aiming to pinpoint areas where these tools could bring significant improvements. While current evidence is still emerging, the review uncovers promising directions for future investigation and underscores the need for a solid, ethical framework to support the responsible adoption of AI in social care practices.

1.1 Research Question and Objectives

The main research question (RQ) is generated as follows:

> *RQ: What are the current gaps and potential opportunities in the implementation of data-driven AI technologies in the social care sector in Wales?*

The key objectives of this research are:

2. To investigate the ethical and emotional implications of using data-driven AI in social care, particularly concerning the loss of human touch, empathy, and interpersonal connection.
3. To assess the level of digital literacy, trust, and acceptance of AI technologies among caregivers, service users, and stakeholders in social care settings.
4. To identify existing gaps and opportunities in the policy, infrastructure, and stakeholder engagement frameworks that influence the effective and equitable implementation of AI in social care in Wales.

2. Methodology

This study adopts a literature-informed, qualitative methodology to explore the landscape of artificial intelligence (AI) applications within social care contexts. Findings are presented according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, to enhance transparency, methodological quality, and reduce bias in the report (Page M. J. & Moher D, 2017). Instead of a rigid systematic review protocol, this study followed a structured yet flexible approach to explore academic and grey literature to capture thematic insights. Due to the heterogeneity and early-stage nature of the evidence, no formal quality appraisal was conducted. The study is therefore best described as a narrative synthesis.

2.1 Eligibility Criteria

The literature reviewed spans the period from 2014 to 2025, capturing developments aligned with the growing demand for technological solutions in aging societies. Studies were included if they focused on AI implementations in long-term care, home care, and nursing home environments, and if they addressed implications for service users and care professionals. Publications that lacked empirical grounding, focused exclusively on technical innovation without application in care settings, or were not published in English were excluded from consideration. Refer to Table 1 for clarity.

Table 1: Inclusion and Exclusion Criteria

Included	Excluded
Publications focusing on social care sector	Publications focusing on sectors other than social care
Publications since 2014	Publications before 2014
Publications in English	Publications in languages other than English
Publications based on Peer reviewed, Open access, Grey literature materials, Systematic literature reviews.	Publications that don't have open access
Publications based on keywords such as Artificial Intelligence or AI, Social Care, Data-driven, Old Age, Caregivers, Long-term care, Homecare.	Keywords other than those mentioned as 'Included'

2.2 Information Sources

Relevant literature was sourced from multiple academic and interdisciplinary databases, including PubMed, IEEE Xplore, Scopus, Google Scholar, and some grey literatures as shown in Table 2. Inclusion of these databases was based on the disciplinary breadth they cover across social care within the context of data-driven artificial intelligence.

Table 2: Databases used

Search Engine	Database Type	Reason
Scopus	Abstract and Indexing	Enhances the visibility and recognition of researchers and institutions.
PubMed	Public biomedical database	Supports scientific and medical research.
Social Care Online	Online database on all aspects of social care	Offers information and research on all aspects of social care from a range of resources including journal articles, websites, research reviews, legislation and government documents, and service user knowledge.
Grey Literature	Outside of peer-reviewed journals	Look for any important studies outside the recognised database, i.e., that may not have been published. Considering the limited studies on the research area of AI in social care, Grey Literatures were not to be ignored.
Google Scholar	Web search engine	Provides a simple way to broadly search for scholarly literature. Moreover, it offers a vast selection of scholarly works, including journal articles, conference papers, theses, dissertations, and preprints. Google Scholar is widely used by researchers due to its sophisticated algorithms and comprehensive selection of scholarly material from various sources.

2.3 Search Strategy

The search strategy was guided by key terms such as “Artificial Intelligence” or “AI”, “Social Care”, and other terms such as “data-driven” or “data driven”, “old age”, “caregivers”, and “service users” were also used as, shown in Table 3, to refine the scope of the review and ensure breadth in coverage. Boolean operators were applied to construct effective search queries, with particular attention given to themes related to aging and community-based care.

Table 3: Search Strategy

Search Engines	Search Strings
Scopus	(TITLE-ABS-KEY (data-driven) AND TITLE-ABS-KEY (artificial AND intelligence) AND TITLE-ABS-KEY (social AND care) OR TITLE-ABS-KEY (old AND age))
	(TITLE-ABS-KEY (data-driven) AND TITLE-ABS-KEY (artificial AND intelligence) AND TITLE-ABS-KEY (social AND care) AND TITLE-ABS-KEY (caregivers))
	(TITLE-ABS-KEY (data-driven) AND TITLE-ABS-KEY (artificial AND intelligence) AND TITLE-ABS-KEY (social AND care))
	(TITLE-ABS-KEY (artificial AND intelligence) AND TITLE-ABS-KEY (social AND care) AND TITLE-ABS-KEY (care AND home))
PubMed	(((data-driven) AND (artificial intelligence)) AND (social care))
Google Scholar	“data-driven artificial intelligence in social care”
Social Care Online	“data-driven artificial intelligence in social care”

2.4 Data Analysis

Data from the selected sources were extracted and organised according to their focus areas, including AI methodology, type of social care setting, and reported outcomes. Given the emerging nature of literature on AI in the care sector (Gholizadeh et al., 2023), we broadened our data collection beyond the UK to gain a global perspective. This approach enabled the identification of higher-quality studies on AI applications in social care

and their relevance to improving systems in Wales. Due to the qualitative nature and diversity of the data, meta-analysis was deemed unnecessary; instead, we focused on key findings that highlighted both opportunities and limitations of AI in this field. A thematic analysis was employed to identify recurrent patterns, implementation barriers, ethical considerations, and areas where further research is required. These findings were synthesised into a structured narrative, supported by summary tables that reflect trends across the literature and highlight underexplored dimensions of AI adoption in social care.

It was noted that these studies differed substantially in terms of quality, settings, and outcomes. Some explored the need for AI in social care, while others addressed its potential challenges. To assess and relate these diverse findings, a narrative synthesis was conducted. This involved reviewing and integrating results to identify patterns and draw conclusions, using a thematic framework and tabular format. This method provided a comprehensive understanding of the topic by revealing key themes and discrepancies across the studies.

This methodological approach enables a nuanced understanding of the interface between emerging AI technologies and the complex needs of social care environments, while also drawing attention to the gaps in evidence and areas ripe for future innovation.

3. Results

A total of 648 records were initially identified, 646 through database searches and 2 from additional sources. After removing duplicates, 647 records were screened, resulting in the exclusion of 499 based on language, date, and relevance. Of the 148 full-text articles assessed, 126 were excluded due to being outside the scope of social care, lacking specific reference to AI, or reporting irrelevant outcomes. A final set of 22 studies was included in this narrative synthesis (see Figure 1, PRISMA diagram), which provided the foundation for analysing current applications, opportunities, and challenges of AI in the social care sector.

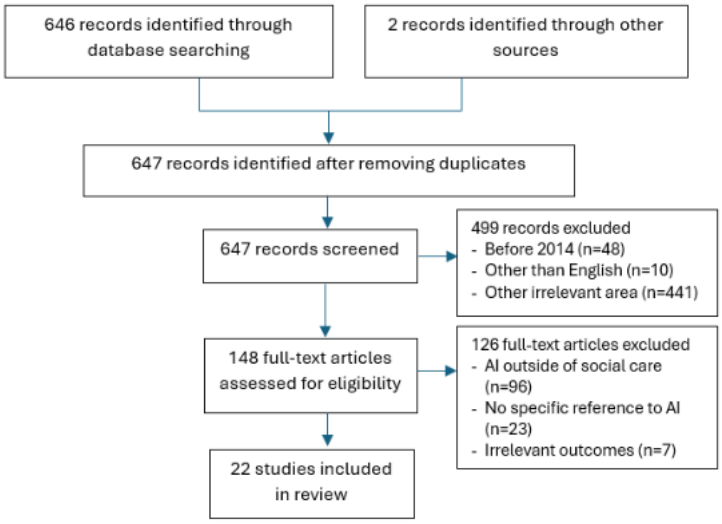


Figure 1: PRISMA flow diagram (Source: Page M. J. & Moher D, 2017).

The final set of 22 studies (from Figure 1) yielded a total of 38 findings, contributing to multiple thematic areas as illustrated in Figure 2. These categories were developed based on the principal insights derived from the included studies. Notably, many studies addressed multiple thematic areas, resulting in a higher number of findings (n=38) than studies (n=22). The thematic framework facilitated these findings into interconnected domains such as ethical implications, emotional impact, stakeholder engagement, and AI readiness in social care. Considerable variations were observed across the studies in terms of methodological quality, contextual settings, and reported outcomes. To systematically explore these dimensions, a narrative synthesis was undertaken. This involved organising the data and synthesising findings into a structured, tabular narrative. The synthesis approach enabled a comprehensive analysis, allowing for the identification of key patterns, thematic overlaps, and points of divergence across the evidence base.

As shown in Figure 2, the most frequently cited theme was the necessity of digital literacy and a multidisciplinary approach (n=7), underscoring the need for cross-sector collaboration and digital capacity-building within the social care workforce. Understanding, preconceptions, and acceptability of AI emerged as the second most

prominent theme (n=6), reflecting the importance of addressing public perceptions and cultural readiness for AI adoption.

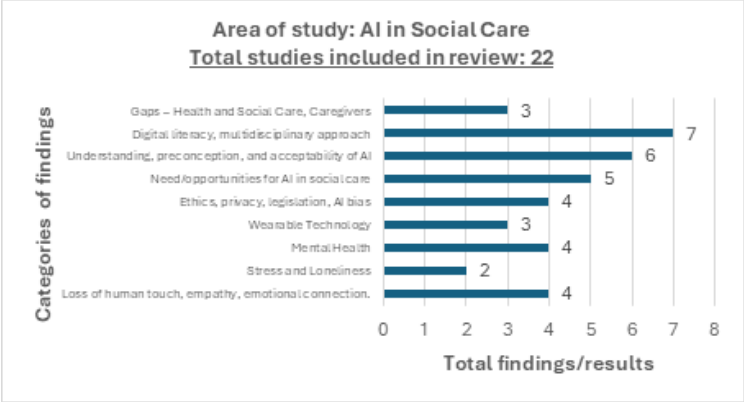


Figure 2: Frequency of key themes identified in the reviewed studies on AI in Social Care.

Further thematic clusters included identified needs and opportunities for AI integration in social care (n=5), and concerns related to ethics, privacy, legislation, and algorithmic bias (n=4), highlighting ongoing debates around the responsible and equitable deployment of AI technologies. Additional themes such as mental health support, loss of human touch and emotional connection, and wearable technology (n=3–4) point to both the potential and the sociotechnical challenges of AI use in person-centred care. The theme of stress and loneliness was least represented (n=2), indicating a relative gap in the literature that warrants further investigation.

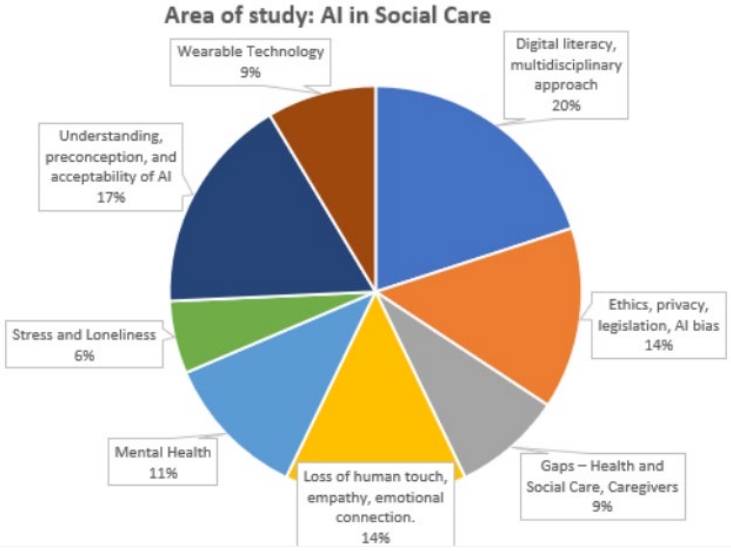


Figure 3: Distribution of research focus areas in AI and Social Care.

The narrative synthesis also revealed considerable variation in methodological quality and focus across the included studies. While some were exploratory and technology-focused, others engaged with sociocultural and ethical dimensions of care. The absence of formal quality appraisal in this synthesis reflected the heterogeneity and formative state of the literature. As such, the synthesis prioritised breadth of insight over uniform methodological rigour.

Figures 2 and 3 illustrates a broad but uneven research focus, suggesting that while technological and ethical dimensions are gaining traction, emotional, relational, and experiential aspects of AI in social care remain underexplored.

Table 4 presents representative findings organised thematically and by study. It captures how AI is currently positioned across multiple dimensions of social care, ranging from decision support and service efficiency to emotional wellbeing and caregiver relief, while also drawing attention to persistent challenges around ethics, inclusivity, and implementation.

Table 4: Characteristics of Included Studies

Category	Author(s)	Findings
Loss of human touch, empathy, emotional connection (n=4)	• Neves, B. B., Petersen, A., Vered, M., Carter, A., & Omori, M. (2023). • Fernando, N., & Ranasinghe, P. (2023). • Meskó et al. (2018). • Wimbarti et al. (2024).	• AI may support care elements such as dementia care, but concerns exist about loss of empathy and the human element. • AI lacks the emotional understanding needed for accurate diagnosis and meaningful care relationships.
Stress, Loneliness (n=2)	• Vuppalapati et al. (2018). • Neves et al. (2023).	• AI models can detect stress and loneliness using EEG and social technologies (e.g., voice assistants, robots) to support isolated residents.
Mental health, learning disability, dementia (n=4)	• Yadav et al. (2024). • D'Alfonso (2020). • Yoo et al. (2024). • Social Care Wales (2024).	• AI shows promise in assessing quality of life, predicting mental health issues, and offering personalised therapy. • Data-driven AI methods can be employed to develop prediction/detection models for mental health conditions. • SAR (Social Assistive Robots) like Hyodol can reduce depression suggesting its potential as a supportive companion for solitary older adults. • AI apps such as "PainChek" improves pain assessment and care planning. It could lead to a reduction in the use of medication as it can provide more accurate pain measurements for people with dementia. Care homes in other regions of Wales and in England are also looking to adopt the technology.
Understanding, preconception, and acceptability of AI (n=6)	• Maguire et al. (2021). • Milovich et al. (2024). • Neves et al. (2023). • Lanne, M., & Leikas, J. (2021). • Loveys et al. (2022). • Neves et al. (2023).	• Lack of user engagement and trust, concerns over data use, stereotypes, and insurance coverage can affect AI adoption, especially in LTC (Long-term Care) settings. • Acceptability of AI-enhanced interventions seems to be limited especially in old-age care or LTC leading to difficulty in getting follow-up data due to loss of physical and mental capacity of old age people. • Anxiety related to age-related stereotypes about present older generations and their distrust of and inability to use technology could possess a barrier to AI in social care.
Gaps – Health and Social Care, Caregivers (n=3)	• Cresswell et al. (2020). • Zuschnegg et al. (2021). • Maguire et al. (2021).	• Limited and inconsistent evidence of AI effectiveness to support decision-making in health and social care settings. • Research gaps in social care and a lack of Randomised Control Trials (RCT). • Replacing human caregivers with SARs (social assistive robots) is not the aim; the aim is to fill the gaps where humans are not available, amplify human work, and offer relief for caregivers. • NHS and social care differ in digital maturity.

4. Discussion

The integration of artificial intelligence (AI) in social care presents a dynamic landscape marked by both potential and concern. Drawing from the synthesised data in Table 4, several key themes emerge, each bearing implications for policy, practice, and future research.

4.1 Emotional, Relational, and Experiential Aspects of AI in Social Care

Multiple studies have highlighted the potential erosion of human empathy and the emotional connection inherent to caregiving as one of the key concerns. Neves et al. (2023) and Meskó et al. (2018) emphasise that while AI can aid in daily living activities and clinical decision-making, it cannot replicate the nuanced understanding that comes from human interaction. Wimbarti et al. (2024) reinforce this by highlighting how AI lacks alignment with subjective human reasoning, particularly in emotional contexts. These findings caution against over-reliance on AI tools, advocating instead for hybrid models where AI complements rather than replaces human care.

AI applications show promising advancements in supporting individuals with complex health conditions. For instance, Yadav et al. (2024) present a model that objectively assesses the quality of life for people with intellectual disabilities (ID), addressing caregiver challenges. Similarly, the use of social assistive robots (SARs), as explored by Yoo et al. (2024), demonstrates reductions in depression among older adults, illustrating AI's potential to enhance mental health outcomes. Tools like the PainChek app (Social Care Wales, 2024) further showcase AI's utility in pain assessment, leading to more precise treatment decisions and resource optimisation in care homes.

Vuppalapati et al. (2018) and Neves et al. (2023) examine AI's capacity to monitor and mitigate stress and loneliness, notably through EEG-based stress detection and AI companions like chatbots and voice assistants. These interventions could play a crucial role in addressing the psychological dimensions of aging and institutional living, although their long-term effectiveness and ethical implications remain areas for continued scrutiny.

The acceptability of AI technologies among service users and other stakeholders is significantly shaped by understanding, trust, and systemic readiness. Maguire et al. (2021) and Milovich et al. (2024) point to critical barriers such as data privacy concerns, technological unfamiliarity, and lack of institutional support (e.g., insurance coverage). Moreover, Neves et al. (2023) highlight how ageist stereotypes and digital distrust among older populations compound these challenges, suggesting that educational and participatory design strategies are essential for meaningful adoption.

4.2 Gaps in Research and Practice

Despite these developments, substantial gaps persist. Cresswell et al. (2020) reveal a striking lack of robust evidence, especially in social care settings, regarding the effectiveness and contextual adaptability of AI. The absence of randomised controlled trials (RCTs) and implementation studies limits our understanding of AI's true impact. Additionally, the divide in digital maturity between NHS providers and social care systems (Maguire et al., 2021) suggests a systemic inequity that must be addressed through policy and infrastructure investment. Zuschnegg et al. (2021) reinforce that the goal of AI is not replacement, but augmentation of human care, i.e., filling gaps where caregivers are unavailable and alleviating workload pressures. This perspective reorients the debate from automation to augmentation, which is critical for ethical and practical AI integration.

4.3 Implications for Practice and Policy

The findings highlight that while AI offers significant potential in social care, its implementation must be grounded in human-centred principles. Policymakers and practitioners should ensure that AI enhances, rather than replaces, personal interactions. Strengthening digital literacy and trust, particularly among vulnerable groups, is essential, alongside addressing ethical concerns related to data use and accountability. Inclusive, co-designed approaches involving stakeholders at all stages are also crucial to ensure equitable and effective deployment.

4.4 Barriers and Enablers

Table 5 shows set of challenges that can potentially hinder adoption of data-driven AI in Social Care.

Table 5: Barriers and Enablers

Barriers	Enablers
Loss of Human Touch and Empathy- AI lacks empathy, intuition, and emotional connection.- Concern over replacing human caregivers.	Targeted Clinical Support- Supports people with dementia and intellectual disabilities via reminders and assessments.
Misalignment with Clinical Reasoning- AI doesn't align well with subjective, human-centred clinical decisions.	Mental Health and Wellbeing Monitoring- EEG-based and smartphone sensing models for stress/emotion detection.
Lack of Trust and Acceptability- Scepticism among users and families.- Poor communication and preconceptions, especially in LTC.	Social Connection- SARs, chatbots, and assistants can reduce loneliness in older adults.
Ethical and Privacy Concerns- Uncertainty around data use and third-party agreements.	Enhanced Pain Assessment- Tools like PainChek offer more accurate pain evaluations, reduce medication use.
Digital Divide and Training Gaps- Limited familiarity among users and support networks.- Financial barriers such as lack of insurance coverage.	Resource Optimisation- Frees up staff time and may reduce hospital admissions through better care management.
Limited Evidence and Research Gaps- Lack of high-quality trials and research on barriers/enablers.	Scalability Across Populations- AI tools effective beyond initial target groups (e.g., dementia to mental health).
Technology Maturity and Integration Issues- Social care lags behind NHS in digital readiness.- Inconsistent integration and use.	Addressing Workforce Shortages- AI can compensate for lack of available caregivers due to aging population.
	Vision for Augmentation, Not Replacement- AI supports and enhances human work, doesn't replace caregivers (per Mataric).

On the barriers side, concerns centre around the loss of human qualities, such as empathy and trust, along with technical limitations, like misalignment with clinical reasoning and a lack of digital readiness. Ethical issues, data privacy, and resistance from older adults also hinder adoption. Conversely, the enablers show that AI can enhance, not replace, care, especially through better diagnostics, pain assessment, and mental health support. It helps bridge workforce gaps, reduce loneliness, and improve efficiency if implemented thoughtfully and inclusively.

In essence, AI's success depends not just on what it can do, but how well it's integrated into human-centred care systems.

This narrative synthesis highlights a critical dual challenge in applying AI to social care: advancing innovation while preserving the human element and achieving ethical integration alongside scalable implementation. Existing literature demonstrates the potential of AI to address persistent issues in care delivery yet also underscores the risks of undermining essential human-centred practices.

5. Conclusion

This narrative synthesis of available evidence has explored the current body of research on data-driven AI in social care, revealing a growing interest in how such technologies can enhance care delivery, efficiency, and decision-making. Across various international contexts, AI has shown potential to support mental health interventions, facilitate pain assessment, reduce loneliness, and assist in managing complex conditions such as dementia and intellectual disabilities.

However, the review also identifies critical limitations in the existing literature. These include a lack of longitudinal evidence, insufficient stakeholder engagement, and limited attention to ethical, emotional, and systemic considerations. Most notably, while the global literature reflects increasing innovation in this field, there is a significant gap in research focused specifically on Wales. Despite the region's growing policy interest in digital transformation and social care reform, few studies have examined the opportunities, challenges, or readiness for implementing data-driven AI in Welsh social care settings.

This gap highlights a pressing need for future research that not only builds on international insights but also investigates the specific contextual, infrastructural, and policy factors shaping AI adoption in Wales. Such work should prioritise inclusive, human-centred design and contribute to the development of governance frameworks

that ensure ethical, equitable, and sustainable AI integration. Addressing these gaps will be essential to informing both strategic investment and responsible innovation in Welsh social care.

Ethics Declaration

Ethical approval was not required for this study, as it involved a narrative synthesis of publicly available literature and did not include any primary data collection involving human participants. All data analysed were drawn from published sources, including peer-reviewed articles, grey literature, and open-access materials, and therefore posed no ethical risk to individuals or organisations.

AI Declaration

AI tools were used in this review to assist with grammar correction, spelling, and improving clarity of expression. These tools also provided support in managing writing-related stress and focus challenges associated with the author's ADHD. All intellectual content, analysis, and interpretation were independently developed by the author.

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Financial Inclusion as a Pathway to Informal Sector Sustainability in Africa

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Abstract: Small, Medium and Micro-sized Enterprises (SMMEs) are the backbone of economies worldwide. However, the 'unseen economy challenges' hinder their sustainability in developing markets. Many informal businesses operate outside formal financial systems, limiting access to credit, banking services, and growth opportunities. Financial institutions are pivotal in addressing these barriers by enhancing access to financial systems and developing innovative financial products. This study examines how financial inclusion, embedded within an ecosystem approach, can assist businesses in the informal sector to become more sustainable in the long term. Using a qualitative design, the study investigates how formal and informal finance intersect to support informal SMMEs in South Africa and beyond. A structured literature review and thematic analysis of studies from the last seven years inform the development of a conceptual framework linking financial inclusion to informal business sustainability. The framework incorporates the SMART goal-setting approach to guide financial institutions in engaging with informal businesses. The study emphasises a holistic approach, integrating financial inclusion, ecosystem support, and tailored financial products for informal businesses. The proposed framework advocates for a support ecosystem where informal lenders and formal institutions can work together to tackle issues such as cash reliance, theft risks, and limited growth opportunities. Formal financiers may want to become part of a support ecosystem that is transforming into an attractive option, even for the bankable in informal markets. Recommendations include collateral alternatives, administrative simplicity and trust-building strategies to enable financial institutions to serve this market more effectively. The study also identifies priorities for future research, including practical tools and policy pathways that foster deeper financial integration for informal businesses.

Keywords: Business Sustainability, Ecosystem Support, Financial Inclusion, Formal Finance and Intermediation, Informal Finance, Informal Sector

1. Introduction and Background

The growth of SMMEs in emerging economies is closely tied to a country's economic development (World Bank, 2019). SMMEs also have a positive impact on reducing unemployment and alleviating poverty by improving the living standards of community members (Benedict et al., 2021; Masanga & Jera, 2017; Mago & Modiba, 2022). However, business sustainability, "the ideal paradigm of development" (Sultana, Rahman & Khanam, 2022:438), remains a persistent concern in informal markets, with financial exclusion, the inaccessibility of disadvantaged and low-income groups to financial instruments in the formal financial market, cited as the major contributing factor (Fatoki, 2021; Sherwani et al., 2024; Sultana et al., 2022). In part, this is due to the rigidity and inflexibility of formal financial institutions, which frequently regard a significant number of business owners as unbankable. As a result, informal finance, "small, unsecured and short-in-maturity funding capital", and microfinance emerged as popular alternatives (Nguyen & Canh, 2021:1546). These informal financial mechanisms produce both intended and unintended consequences, fostering a dynamic and innovative ecosystem of support for these business owners (Mago & Modiba, 2022; Mpofu & Sibindi, 2022; Nguyen & Canh, 2021). Theoretically, scholars must reconsider how the Financial Intermediation Theory is applied to explain informal finance since its main focus is on formal financial institutions (Mabote, 2017; Nguyen & Canh, 2021). On a more practical level, formal financial institutions should recognise the substantial demand and opportunity in the informal sector, and join the conversation to transform the unbankable into the bankable.

2. Literature Review

This section is used to set the scene and give context to specific definitions and understandings of theory. A systematic review of the literature including a presentation of themes is covered in section 4.

2.1 Informal Finance and Ecosystem Support

According to Mpofu and Sibindi (2022), SMMEs in the informal sector use informal finance for two reasons. First, they often have no other option: formal funding mechanisms are inaccessible to them. Second, some entrepreneurs actively prefer informal finance, because it typically requires no collateral, tolerates information asymmetry, and offers more flexibility, convenience, and fewer administrative hurdles than the formal lending

process. Consequently, the role of formal financial intermediaries in supporting these entrepreneurs is diminishing compared to the innovative solutions offered through informal finance (Archer et al., 2020; Ogujiuba et al., 2023). And because ecosystems, as Ogujiuba et al. (2023:157) state, "function under different conditions and circumstances that are unique to each ecosystem," formal financial intermediaries must be guided to align their lending mechanisms better with the needs of this sector. Therefore, understanding how and why informal finance works in informal markets becomes imperative.

According to the Financial Intermediation Theory, funds are channeled from "surplus savers to deficit spenders through market created mechanisms" (Mabote, 2017:1); however, with informal finance, this is not channeled through financial intermediaries but rather through various role players such as *moneylenders* providing loans to SMMEs. High interest rates typically accompany these loans, but they offer a convenient and quick way to obtain cash. They can also be extended if additional funds are needed (Adams & Hunter, 2019; Mago & Modiba, 2022). Several other types of informal financial mechanisms exists, like *Pawnbrokers* (Adams & Hunter, 2019; Mago & Modiba, 2022)*, Merchants or traders* (Mago & Modiba, 2022; Wang & Kong, 2019), *Rotating savings and credit associations (ROSCAs)* (Ky et al., 2021; Jiang, 2009; Mabwe & Dundu, 2018, Mago & Modiba, 2022; Tengeh & Nkem, 2017), *Landlordism* (Adams & Hunter, 2019; Mago & Modiba, 2022; Nor & Masron, 2019) and *microfinance* (Masanga & Jera, 2017).

Together, these mechanisms and role players present a multitude of benefits, of which are intended. Firstly, it provides access to finance through loans that promote business growth for SMMEs — opportunities that are often unavailable to these entrepreneurs in formal financial markets (Mago, 2020). Secondly, informal finance empowers these entrepreneurs by improving their businesses' cash flow (Nguyen & Canh, 2021; Wellalage & Fernandez, 2019). Thirdly, informal finance promotes saving among role players by offering higher returns when lenders borrow from them, encouraging a stronger savings culture (Adams & Hunter, 2019; Ky et al., 2021). The unintended benefits include the establishment of a suitable web of (usually informal) relationships, characterized by trust and mutual value exchanges (Adams & Hunter, 2019). Case in point, by lending and borrowing funds, borrowers learn to be disciplined when setting criteria for loans and monitoring repayments, and lenders learn to honour the agreements and consistently repay their loans (Du & Cheng, 2022).

2.2 The Financial Intermediation Theory and Financial Inclusion

According to Mabote (2017:1), "Financial Intermediation is the process in which funds are channeled from the surplus savers to deficit spenders through market created mechanisms, such as, financial institutions". The Financial Intermediation Theory further posits that financial intermediaries "serve to reduce transaction costs and informational asymmetries" (Mabote, 2017:1). However, developments in technology and deregulation, some of which are linked to the financial technology (FinTech) disruption – are altering the landscape for the banking sector as one of the formal financial intermediaries. According to Mpofu and Sibindi (2022), information asymmetry in the informal sector is high, which means that formal financial institutions tend to avoid lending funds to businesses in this sector, inhibiting financial inclusion, defined as the easy access of disadvantaged and low-income groups to financial instruments in the formal financial market (Sherwani et al., 2024). In this context, it is important to investigate further the formal intermediaries' failure to serve this sector effectively, the widening financial inclusion gap, and the possible role of informal finance in supporting the informal ecosystem in line with the Financial Intermediation Theory (Alhassan et al., 2019).

3. Methodology

3.1 Research Design

The study used a qualitative, conceptual design (Braun & Clarke, 2006). In seeking to understand the complex relationship between financial inclusion and the long-term sustainability of SMMEs and informal businesses in South Africa, an interpretivist paradigm was deemed most suitable (Weber, 1949). This paradigm enables the study to contribute to theory by organising, analysing, interpreting, synthesising, reframing, and extending existing knowledge. The steps used for the conceptual development included a systematic literature review, thematic synthesis, and framework development.

3.2 Data Collection and Selection Criteria

This study drew on existing academic literature. Peer-reviewed journal articles published between 1 January 2017 and 31 December 2024 were systematically sampled, with specific inclusion criteria linked to the main

theme of this study and consisting of the following specific keywords: business sustainability, informal sector, informal finance, ecosystem support, financial inclusion, and formal financial intermediaries. Table 1 shows an overview of this. Not all keyword searches for all databases gave suitable results, so those were excluded and are hence omitted from the table.

Table 1: Databases used to source academic articles using selected keywords

Database / Book / White paper	Keywords	# of Papers
Book Chapter	Informal finance /	1
Book Chapter	Sustainability / informal sector	1
EBSCOhost	Ecosystem support	1
EBSCOhost	Informal finance	5
EBSCOhost	Formal finance and intermediation	4
EBSCOhost	Sustainability / informal sector	1
Emerald Insight	Financial inclusion	1
ProQuest	Informal finance	2
ProQuest	Financial inclusion	1
ResearchGate	Formal finance and intermediation	1
Science Direct	Financial inclusion	1
Sabinet	Informal finance	1
White paper	Informal finance / Formal finance and intermediation	1
Wiley Online Library	Sustainability / informal sector	1

Articles were only included if they contained valuable insights relevant to the informal sector, business sustainability and financial ecosystems in developing contexts. Even though the study's focus is South Africa, it was decided to include the whole African context and some Asian literature. This is because the topic primarily relates to informal businesses, and research is scarce when the scope is too narrow. Only English-language sources with clear methodological rigor were considered. Literature with a pure focus on formal economies or formal financial systems were excluded, as were resources like grey literature, opinion pieces and publications without formal peer-review processes.

3.3 Thematic Analysis and Conceptual Framework Development

Lincoln and Guba's (1985) principles for qualitative research quality were applied to ensure methodological rigor. The systematic search for articles helped with credibility and the clear audit trail improved dependability. Transparent inclusion criteria supported confirmability, while detailed contextual descriptions improved transferability to other informal markets. Findings were synthesised into a conceptual framework, showing the current situation and future possibilities. Finally, actionable recommendations were derived and presented through the lens of the SMART framework (Doran, 1981).

4. Results and Discussion

4.1 Thematic Analysis of Key Studies

Key studies were categorized by letters A to E into specific themes, which were then brought into a suitable narrative order, as presented in Tables 2 to 7 below.

4.2 A Sustainable Informal Sector in Context: Challenges and Opportunities (Letters A and B)

Looking firstly at business sustainability in the informal sector (Table 2), it becomes clear that funding, a crucial ingredient for any business to survive and thrive, is a long-standing contentious topic among scholars (Sultana et al., 2022). Formal financial institutions, acting as intermediaries between surplus savers and deficit spenders, are the lifeline for many entrepreneurs establishing and growing their small, medium or micro enterprises (Mabote, 2017; Mpofu & Sibindi, 2022). Informal finance, therefore, became a substitute for inaccessible formal

financial mechanisms to maintain business sustainability in the informal sectors of these emerging markets (A1-A4). The Financial Intermediation Theory's central premise is to reduce transaction costs and informational asymmetries; however, practically, this may not always apply, as suggested by the papers in Table 3 (B1-B7), in the informal sector (Mabote, 2017). Many of these entrepreneurs are unable to comply with the rigorous qualifying criteria, which are aimed at the bankable; those entrepreneurs who can convincingly show their businesses are viable. In contrast, the unbankable, those entrepreneurs who are considered high-risk, are often excluded from funding opportunities (Archer et al., 2020; Mago & Modiba, 2022; Ogujiuba et al., 2023). Sultana et al. (2022) specifically looked at the informal sector and its link to sustainability and concluded that informality should be reduced through interventions to speed up the integration of the informal sector into the formal economy of emerging countries. Ediagbonya and Tioluwani (2023) proposed FinTech as a possible solution, focusing on the economic efficiency aim of sustainability (Sultana et al., 2022). FinTech has already produced positive outcomes in various informal sectors; however, they stressed that a suitable environment and supporting regulations are needed for this to work. Therefore, the government's involvement becomes imperative.

Table 2: Theme 1 - Business sustainability in the informal sector is reliant on financial support (A1-A4)

Identifier	Method	Notes
A1 (Adeola et al. 2019)	Book Chapter	CSR and sustainable development
A2 (Mabwe & Dundu, 2018)	Mixed method/No theory	Sustainability of Informal Savings Groups as a Source of Finance for the Zimbabwean Informal Sector
A3 (Sultana et al., 2022)	Quantitative	The Impact of the Informal Sector on Sustainable Development in Emerging Countries
A4 (Tengeh & Nkem, 2017)	Qualitative/No theory	Sustaining Immigrant Entrepreneurship in South Africa. The role of informal finance associations.

Table 3: Theme 2 - Many informal sector businesses rely on informal finance in order to operate sustainably (B1-B7)

Identifier	Method	Notes
B1 (Cama et al., 2024)	Qualitative. Ordinary least squares, instrumental variables, fixed effects, and general Method of moments.	Financial inclusion and the informal sector
B2 (Ediagbonya & Tioluwani, 2023)	Qualitative. Doctrinal, sociological, and comparative research.	FinTech in Driving Financial Inclusion in Developing and Emerging Markets
B3 (Mabwe & Dundu, 2018)	Mixed method No theory	Sustainability of Informal Savings Groups as a Source of Finance for the Zimbabwean Informal Sector
B4 (Masanga & Jera, 2017)	Mixed method Contemporary banking theory Financial intermediation Principal-agency Economic & Institutional theories	The Significance of Microfinance to Urban Informal Traders in Zimbabwe
B5 (Sherwani et al., 2024)	Quantitative. Regression analysis.	Determinants of Financial Inclusion among Women-Owned Enterprises in the Informal Sector
B6 (Sultana et al., 2022)	Quantitative	The Impact of the Informal Sector on Sustainable Development in Emerging Countries
B7 (Wellalage & Fernandez, 2019)	Quantitative	Innovation and SME Finance: Evidence from Emerging Markets

4.3 Informal Finance as an Enabler for Ecosystems (Letters C and D)

Consequently, informal finance, as claimed in the articles in Table 4 (C1-C10), emerged as an alternative for these entrepreneurs, providing them with an informal sector support system, seen in the article in Table 5 (D1), created and maintained by an ecosystem of surplus savers and deficit spenders (Archer et al., 2020; Mpofu & Sibindi, 2022; Nguyen & Canh, 2021; Ogujiuba et al., 2023). Although many informal finance mechanisms emerged, becoming alternative funding options for these unbankable entrepreneurs, it has also developed into an appealing alternative for more affluent entrepreneurs in the informal market due to the flexibility and administrative minimalism accompanying these options, strengthening the informal sector ecosystem of support (Adams & Hunter, 2019; Cao et al., 2019; Ky et al., 2021; Mago & Modiba, 2022; Masanga & Jera, 2017; Nor & Masron, 2019; Wang & Kong, 2019; Wellalage & Fernandez, 2019). Mpofu and Sibindi (2022) specifically emphasised that SMMEs often have no other option or actively prefer informal finance over formal lending. And because each ecosystem is unique, according to Ogujiuba et al. (2023), formal financial intermediaries could align their lending mechanisms with the needs of this sector. Ky et al. (2021) highlighted the role of mobile banking and demonstrated that individuals in the informal sector - despite having irregular incomes and lower levels of education - still show a likelihood of making deposits into bank accounts. This finding supports Ediagbonya and Tioluwani's (2023) later argument regarding the potential of FinTech to enhance financial inclusion. However, although the increasing adoption of mobile money on an individual level influences financial inclusion positively, Nguyen and Canh (2021) have iterated that, from a business level perspective, financial decisions in the informal sector are influenced not only by individual factors but also by organisational and contextual factors. In other words, SMME owners' financial strategies in the informal sector depend on "who owns the firm, what the firm has and where it is located" (Nguyen & Canh, 2021, p.1563). Therefore, individual, organisational, and contextual factors must be considered when considering an ecosystem of support for SMMEs in the informal sector.

Table 4: Theme 3 - Informal financial mechanisms have become the main funding alternative for sustainable businesses in the informal sector (C1-C10)

Identifier	Method	Notes
C1 (Adams & Hunter, 2019)	Book Chapter	Informal finance in low-income countries
C2 (Du & Cheng, 2022)	Qualitative, exploratory.	Banking competition and households' informal financing
C3 (Jiang, 2009)	Book Chapter	The Evolution of Informal Finance in China
C4 (Ky et al., 2021)	Qualitative No theory	Mobile Money Interaction with Formal and Informal Finance
C5 (Mabwe & Dundu, 2018)	Mixed method No theory	Sustainability of Informal Savings Groups as a Source of Finance for the Zimbabwean Informal Sector
C6 (Mago & Modiba, 2022)	Systematic Literature Review	Informal finance for micro and small businesses in Africa
C7 (Mpofu & Sibindi, 2022)	Literature survey	Informal finance for African SMEs
C8 (Nguyen & Canh, 2021)	Quantitative. Hypothesis testing.	Formal and Informal Financing Decisions of Small Businesses
C9 (Nor & Masron, 2019)	Quantitative No theory	Informal Mode of Financing Used for Construction Financing in Somalia
C10 (Tengeh & Nkem, 2017)	Qualitative No theory	Sustaining Immigrant Entrepreneurship in South Africa. The role of informal finance associations.

Table 5: Theme 4 - Ecosystem support is instrumental for the (financial) success of informal businesses (D1)

Identifier	Method	Notes
D1 (Ogujiuba et al., 2023)	Quantitative. Hypothesis testing.	Interaction and Main Effects of Finance Support and Other Business Support Services on the Entrepreneurial Ecosystem in South Africa

4.4 Barriers to Financial Inclusion (Letters E and F)

The financial inclusion gap, argued by the authors in Table 6 (E1-E3), is narrowing due to technology and deregulation developments that are altering the landscape for the banking sector; however, the formal financial system's reluctance or inability to adjust its approach to consider entrepreneurs for funding who are deemed unbankable still poses a significant challenge (Ediagbonya & Tioluwani, 2023; Mabote, 2017; Mago & Modiba, 2022; Mpofu & Sibindi, 2022; Sherwani et al., 2024). Examining 186 countries, focusing on the informal sector between 2004 and 2018, Cama et al. (2024) found that financial inclusion had significantly reduced the size of the informal sector, also known as the shadow or unseen economy and advocate financial inclusion as an effective vehicle to lower informality. They recommend improved financial infrastructure and inclusive financial environments to this end. Sherwani et al. (2024) posited that information and communication technology (ICT) contributes to an increase in financial inclusion for women entrepreneurs in informal markets, which aligns well with Ky et al. (2021) notion of mobile banking and Ediagbonya and Tioluwani's (2023) notion of FinTech. Still, considering formal lending practices, the financial inclusion gap remains a concern due to information asymmetry as well as high and unnecessary fees (Ediagbonya & Tioluwani, 2023). Although Archer et al. (2020) have shown that the relationship between credit constraints and innovation, specifically in the informal sector, is not always negative, Benedict et al. (2021) stress that financial literacy and tax also significantly affect SMMEs' performance. Therefore, governments should become more involved, as Ediagbonya and Tioluwani (2023) also suggested, to become a more prominent stakeholder in these ecosystems. Formal financial intermediaries, on the other hand, as shown in the articles in Table 7 (F1-F6), must take note and learn from informal markets and how they use informal financial services to support an ecosystem that is becoming an attractive option, even for the bankable in informal markets (Ogujiuba, Eggink & Olamide, 2023).

Table 6: Theme 5 - Financial inclusion is an ongoing concern (E1-E3)

Identifier	Method	Notes
E1 (Cama et al., 2024)	Qualitative. Ordinary least squares, instrumental variables, fixed effects, and general Method of moments.	Financial inclusion and the informal sector
E2 (Ediagbonya & Tioluwani, 2023)	Qualitative. Doctrinal, sociological, and comparative research.	FinTech in Driving Financial Inclusion in Developing and Emerging Markets
E3 (Sherwani et al., 2024)	Quantitative. Regression analysis.	Determinants of Financial Inclusion among Women-Owned Enterprises in the Informal Sector

Table 7: Theme 6 – Formal finance's role in financial intermediation is changing (F1-F6)

Identifier	Method	Notes
F1 (Benedict et al., 2021)	Quantitative Resource-based theory Human capital Upper echelons Taxation theory	Financial determinants of SMEs' performance
F2 (Ky et al., 2021)	Qualitative No theory	Mobile Money Interaction with Formal and Informal Finance
F3 (Nguyen & Canh, 2021)	Quantitative. Hypothesis testing.	Formal and Informal Financing Decisions of Small Businesses
F4 (Archer et al., 2020)	Quantitative analysis. Applied Economics	Credit constraints impede innovation
F5 (Mabote, 2017)	Qualitative, looking at the Financial Intermediation theory	The Role of Non-Bank Financial Intermediation in Lesotho
F6 (Wang & Kong, 2019)	Quantitative. Secondary data analysis.	Financial Constraints, Institutions, and Firm Productivity

4.5 Toward a Hybrid Financial Ecosystem – Lessons From Informal Practice

Figure 1 below provides a possible framework for a hybrid financial ecosystem. Based on the findings, considering business sustainability (A1-A4) in the informal sector (B1-B7), recognising the value of informal finance (C1-C10) in supporting the support ecosystem (D1), formal financial intermediaries (F1-F6) should join the conversation to support financial inclusion (E1-E3) and rethink their lending strategies for this sector.

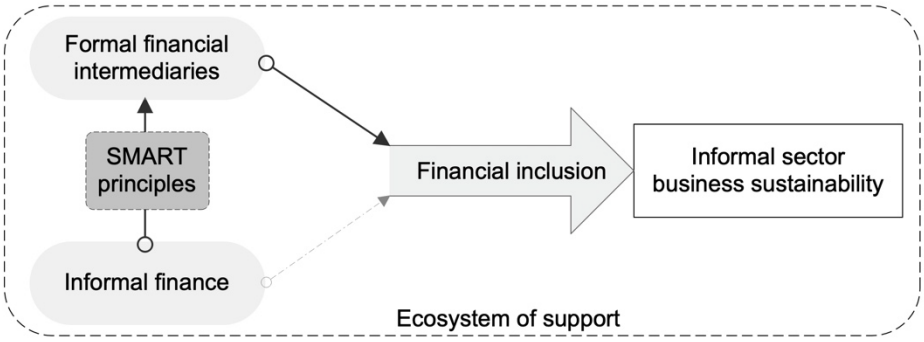


Figure 1: Financial inclusion framework for informal sector business sustainability (Authors own)

Within the framework, informal finance offers a degree of financial inclusion by providing limited support to businesses in this sector. However, it remains insufficient to ensure long-term sustainability. To make these informal sector businesses more sustainable and provide a robust support ecosystem, formal financial intermediaries' funding instruments should be adjusted to align more with those used in informal finance in the informal sector, allowing a more inclusive financial system. In addition, to strengthen these transitions, engagements should be based on smart principles, allowing specific, measurable, achievable, relatable and time-bound goals that are actionable and attainable (Doran, 1981).

5. Recommendations Through the SMART Framework Lens

In conclusion, banks and other formal lending institutions should revisit their informal lending strategies. Collateral comes in many forms, as informal financial mechanisms have shown (Mago, 2020; Mago & Modiba, 2022; Wellalage & Fernandez, 2019), and formal banks and lending institutions should think more widely to appreciate a broader range of data when businesses in the informal sector request funding (Benedict et al., 2021; Nguyen & Canh, 2021). Asah, Louw, and Williams (2020) have shown that various opportunities exist, which include tailored financial products for alternative credit assessment, strategic partnerships and informal sector units, tiered Know-Your-Customer requirements, and financial literacy and support services.

Administrative simplicity is another area for improvement. Many SMMEs are owned, managed, and operated by a single person, which means time away from their business results in a loss of income. Therefore, banks and formal lending institutions must find innovative ways to set measurable and time-bound targets for simplifying the administrative burden on prospective business lenders in the informal sector (Ogujiuba et al., 2023). Banks and formal lending institutions should appreciate the complexities that informal entrepreneurs face when acquiring specific documentation.

The informal sector predominantly relies on cash, exposing businesses and savers to greater criminal risk (Adams & Hunter, 2019; Mago & Modiba, 2022). Its slow adoption of digitalisation may stem from the digital divide or mistrust in formal financial intermediaries. However, FinTech (Ediagbonya & Tioluwani, 2023), and more specifically, mobile banking (Ky et al., 2021), have been shown to be effective alternative mechanisms. This would be a step forward to help narrow the financial inclusion gap, although it must be stressed that governments' involvement must not be ignored. As an essential stakeholder, the government can influence policy reforms to support tax reliefs for SMMEs and offer targeted programmes to improve the financial literacy levels of informal business owners in informal sectors.

While the proposed recommendations aim for long-term impact, short-term wins can be achieved by aligning with SMART principles—ensuring goals are specific, measurable, realistic, relevant, and time-bound (Doran, 1981). Formal financial intermediaries and national economies stand to benefit by engaging more actively with SMMEs in informal markets. This hidden economy holds significant potential, but requires a shift from traditional support models. In the short to medium term, actions should include helping informal businesses weather

economic shocks; longer-term strategies should build a more integrated and sustainable financial ecosystem, where formal and informal finance providers work collaboratively (Alhassan et al., 2019).

Future research could focus in more detail on the how of the following three specific recommendations proposed in this study. Firstly, looking specifically at alternative collateral types with clearly defined indicators supporting business loan applications in the informal sector, secondly, administrative simplicity to decrease complexity and improve efficiency and turnaround times, and thirdly, to investigate ways in which formal financial intermediaries can gain the trust of entrepreneurs in the informal sector to shift their mindsets from supporting a predominantly cash-based to a predominantly digital economic system.

6. Limitations of the Study

As no primary data were collected, some real-world developments may have been missed. Conceptual papers risk becoming summaries of existing work; however, this study mitigated that risk using a diverse range of high-quality sources. Clear definitions, logical consistency, and inclusion of recent works underpinned the approach. The study offers a conceptual contribution by interpreting and connecting existing findings, especially relevant to the African context, but transferable across similar contexts.

Ethics and AI Declarations

Because of the nature of this study, no formal ethics approval was needed. Conceptual papers and systematic literature reviews use past papers to support new ideas and approaches to topics of interest instead of using primary data to support claims. No AI tools were used in planning or developing this paper, but an AI tool called Grammarly assisted with language editing.

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Enhancing Regional Innovation Systems in Cymru (Wales): Lessons from AgorIP and CALIN

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Abstract: This paper presents a practitioner report of two exemplar European Regional Development Fund (ERDF) projects within Cymru (Wales). Namely analysing the AgorIP and Celtic Advanced Life Science Innovation Network (CALIN) business and research support projects within the context of Regional Innovation Systems (RIS) (Cooke et al, 2004; Pino & Ortega, 2018). Cymru has had a long history tied to innovation with Llywodraeth Cymru (Welsh Government) placing the need to encourage Research Development & Innovation (RD&I) and Small and Medium Enterprises (SME) competitiveness at the forefront of their vision for Cymru's future economy. Both lead by Prifysgol Abertawe (Swansea University), the AgorIP and CALIN projects had different delivery models, AgorIP having secondees in external Cymru HEIs and GIG Cymru UHBs (NHS Wales University Health Boards) that supported the delivery at the main hub, and CALIN, a partnership between three Cymru and three Irish HEIs. Jointly supporting over 300 enterprises and organisations across their lifetimes, the projects' outcomes offer the potential to learn from previous publicly funded business support initiatives within the Cymru RIS. This paper will use these outcomes to inform future Cymru RIS support projects that could learn from and improve on the operations of those before it. These new projects should focus on sharing capabilities and avoiding duplication where possible, incorporating and utilising the individual capabilities and knowledge bases of Cymru's HEIs and Science Parks, with the ability to work on projects that combine organisations across Cymru and beyond. Further, the projects should adopt AI-enabled software as a 'shopfront' to engage with users, automate the creation of RIS networks, and provide business support templates and training that can be supplemented by additional support from project partners.

Keywords: Regional Innovation Systems (RIS), Innovation, Technology Transfer, Open Innovation, Publicly Funded Business Support.

1. Introduction

Cymru (Wales) is a small nation within the European landscape. With just over 3 million people, Cymru constitutes just 4.6% of the total population of the United Kingdom and around 8.5% of its landmass (Wales.com, 2025). The majority of the population can be found within the South, in the Capital city of Caerdydd (Cardiff), Abertawe (Swansea), Casnewydd (Newport), and the newly famous Northeastern city, Wrecsam (Wrexham), which hosts everyone's now second favourite football team. The business make-up of Cymru of an estimated, 253,800 enterprises was overwhelmingly occupied by SMEs (Small and Medium-sized Enterprises) (99.3%), of which Micro enterprises (0-9 employees) accounted for 94.6% of total enterprises, mimicking a similar situation in the UK as a whole (Melanie Brown, 2023; Georgina Hutton, 2024). However, Cymru does not mimic the UK's GDP per capita, which has been consistently lower than all UK regions (except for North-East England) at 74% of the UK average (Gov.Wales, 2024). Cymru is also over 3 percentage points below the English WEMWBS Wellbeing average, 48 to 51.15 respectively, corresponding to a medium mental well-being (Gov.Wales, 2023; NHS England, 2022).

These shortfalls in the economy and mental wellbeing of Cymru made it a target of the European Regional Development Fund (ERDF), especially in the less developed areas of West-, North-Cymru, and the Valleys, where over €2 billion were invested from 2014-2020 (Welsh Government, 2022b). Much of this investment into Cymru was to encourage Research, Development, & Innovation (RD&I) and SME Competitiveness. This supported

projects such as the AgorIP (which also had funding from Llywodraeth Cymru (Welsh Government)), Celtic Advanced Life Science Innovation Network (CALIN), and ASTUTE projects which delivered support for these aims, with CALIN also linking this support to the Republic of Ireland (RoI) (Welsh Government, 2022b). These projects, based within Higher Education Institutions (HEIs) in Cymru, used a technology transfer model of expertise and funded support that external organisations could access to support their RD&I projects. The projects aligned specifically to Objective 1.2 of ERDF Priority Axis 1: Promoting Research and Innovation – "to increase the successful translation of research and innovation processes into new and improved commercial products, processes and services, in particular through improved technology transfer from HEIs", that also provided support for commercialisation, protection, and exploitation of research to improve market readiness (Welsh Government, 2019). This successful investment into Cymru's economy influenced Llywodraeth Cymru's renewed focus on these activities in its Wales Innovates delivery plan to increase the country's competitiveness as it transitions further into a post-industrial economy (Welsh Government, 2023).

Regarding the funding situation for future projects, the CALIN and AgorIP projects benefited from participating in the aforementioned ERDF programme. With parts of Cymru, such as the West-Cymru and the Valleys (WCV) region's ERDF designation as a lesser developed region (75% less GDP per person than the EU average), the funding for ERDF (See Figure 1) showed a significant focus on Cymru through the funding per person statistic (Goddard, 2021). However, it is important to note that this data does not reflect the funding per person for individual counties.

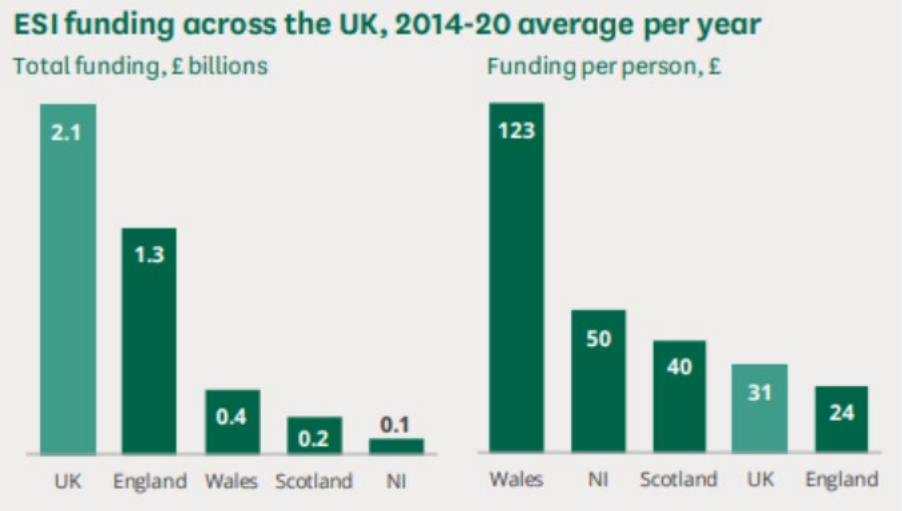


Figure 1: ESI Funding Across the UK, 2014-20 Average Per Year

(Source: Goddard, J. (2021). Brexit: Replacing EU funding in Wales, House of Lords, 2025. Retrieved May 30, 2025, from https://lordslibrary.parliament.uk/brexit-replacing-eu-funding-in-wales/)

In terms of replacement funding, post-Brexit, the UK government promised to match the previous ERDF and European Social Fund (ESF) contributions to Cymru through the United Kingdom Shared Prosperity Fund (UKSPF) on a ramping up basis, eventually matching the EU funding in 2024-25 (Department for Levelling up, Housing & Communities, 2022). However, there are members of Llywodraeth Cymru that believe this resulted in a shortfall of funding for Cymru due to the non-immediate replacement of the £291m per annum received by Cymru through these funding mechanisms (Welsh Parliament Finance Committee, 2022). Problems with the possible duplication of business support and skills projects were also raised in inquiries into the UKSPF in Cymru. Where regional applications that differed in capability, resource, and objectives could have benefited from a less fragmented, local intervention, and instead been integrated and coordinated with other existing provisions or on a larger scale (Economy, Trade and Rural Affairs Committee, 2023).

For the impact on Cymru's HEI sector, in 2015/16 Cymru's universities received £29.3m ERDF and £16.5m ESF funding with £48.6m for further collaborative research from the EU, accounting for £94.4m, just over 6% of total income (Universities Wales, 2018). Since 2014, universities in Cymru were the second largest recipient of EU structural funds, amounting to over £350m as lead partners, showing a significant loss if this level of funding were to be made unavailable (Universities Wales, 2023). This success of Cymru's HEIs in EU programmes appears to not have been replicated within its UK replacements post-Brexit. With Cymru, along with Northern Ireland, consistently receiving the least UKRI (UK Research and Innovation) investment in proportion to local GVA from

2021-2024, receiving £168m in 2023-24 (UKRI, 2025). This overview suggests that Cymru and its HEIs suffered from a lack of funding post-Brexit, and changes may need to be made to ensure that the same level of funding can be accessed in the future.

This paper intends to explore the possible use of Information Communication Technology (ICT) systems that can improve skills, encourage better decision-making, and act as a "shop window" for an innovation support project within a larger RIS in Cymru. This system would learn upon the needs of previous projects and provide hands-off skills training and templates for participating organisations and individuals to exploit their intellectual property and innovations with supplementary RD&I, research, and commercialisation support being provided by the partner organisations within it. Samara et al's (2024) exploration of the relationship between R&D and ICT in RIS found a two-way dynamic between the two, with both being strongly associated with innovation, there's every indication that they are complementary. Whilst this is not in direct relation to the use of any one ICT system, it suggests a likelihood in the acceptance of the system and its usage by innovators within RISs. There is also a quantifiable correlation between R&D personnel and increased computer and internet usage, especially relating to online learning (Samara et al, 2024).

This paper will explore the AgorIP and CALIN projects, analyse their final outputs and show the appetite and potential in Cymru for RD&I and SME competitiveness support in the business, HEI, and health sectors. Furthermore, this paper aims to highlight the need for a similar pan-Cymru, multi-sector RD&I project that can support commercialisation and innovation in the public, private, and third sectors without a specific focus on any industry (CALIN was focused solely on life sciences), the ability to work with partners outside of Cymru, and comprised of the specific expertise and capabilities of multiple HEIs, science parks, and other supplementary organisation.

2. Methodology

This paper will be a practitioner report and analysis of the AgorIP and CALIN projects, detailing their strengths and weaknesses and making recommendations based on their outcomes. The analysis will consist mainly of secondary data from the final project reports, including in-person interviews and surveys with key project stakeholders and team members. These final reports will be compared with Llywodraeth Cymru's intentions for the current RD&I landscape, including support provision and funding landscape, post-Brexit.

3. Regional Innovation Systems (RIS) and the Innovation Ecosystem in Cymru

Cymru has a closely tied history with innovation. The first industrial revolution saw Cymru spearhead the UK copper and coal industries from the late Eighteenth Century (with the later introduction of steel) until their decline through to the end of the Twentieth. This was arguably due to the close geographical system of mineral extraction, refining, and transport, with Abertawe at one point being labelled *Copperopolis,* producing over 50% of global copper in the Nineteenth Century (Evans & Saunders, 2015). Swiftly onto the late 1990s, with the arrival of Asian 'Tiger' firms, such as Sony and Matsushita (later Panasonic), Cymru briefly became an innovation darling for the Regional Policy Directorate of the EU due to its focus on lean production, global sourcing and supplying, and technology marketing (Cooke et al, 2004). This led to Cymru running the first Regional Technology Plan pilot in 1994, the precursor to Regional Innovation Strategies (RIS) (Cooke et al, 2004).

RISs are defined by Cooke et al (2004) as "interacting knowledge generation and exploitation subsystems linked to global, national, and other regional systems". Whilst not necessarily linked to any specific sector, RISs contain interlinked actors, such as industry, research, and public sector organisations that operate RD&I and commercialisation activities (Pino & Ortega, 2018). Whittington et al (2009) suggest that organisations and institutions (HEIs in the case of AgorIP and CALIN) are essential to RISs to create networks and connect organisations within and beyond RIS boundaries. Whilst separate from RIS due to its deemphasis on geography, the triple helix model of university-industry-government relations similarly emphasises the importance of HEI's knowledge bases in enhancing the exploration and exploitation of innovations (Leydesdorff & Zawdie, 2010). Llywodraeth Cymru echoed this in its 2022 Innovation Strategy, highlighting the need for RD&I and IP exploitation through collaborations between HEIs, businesses, and the public sector, i.e. GIG Cymru (Welsh Government, 2022a). The University Health Board (UHB) structure was created by Llywodraeth Cymru to encourage this collaboration between the public sector and HEIs in training and RD&I (Cardiff and Vale University Health Board, 2025). However, collaboration may be more effective when there is dedicated RD&I support within HEIs with the remit to support the public sector, create networks, and connect it to other organisations.

4. AgorIP

AgorIP (OpenIP, translated from Welsh) was one such project set up to provide the much-needed RD&I, Intellectual Property (IP), and commercialisation support identified by Llywodraeth Cymru and ERDF (Swansea University, 2020). Based at Prifysgol Abertawe, AgorIP was originally an ERDF project created to support SMEs and HEIs in the previously identified ERDF target areas that lacked sufficient innovation resources, later funding from Llywodraeth Cymru made the project pan-Cymru, included support for GIG Cymru (NHS Wales), and created secondees that could facilitate joint HEI, SME, and public sector innovation projects (AgorIP, 2022a). The project was based around an open innovation model of support, including IP protection & exploitation, including patent, trademark, and design rights; RD&I, including technical, prototype, and design; and commercialisation, including marketing, product deployment, and supplier acquisition (AgorIP, 2022c). The expansion to support GIG Cymru included the secondment of in-house secondees into five University Health Boards to assist GIG staff and innovation teams with the aforementioned support (AgorIP, 2022b).

Due to its split between the original focus of WCV and then including East-Cymru, the final indicators for the success of the project were equally split. AgorIP exceeded expectations in WCV, surpassing 7 out of 8 indicator targets by the end of its operation in June 2023 (See Table 1.). It achieved particularly strong results in private investment matching public RD&I funding (185%), supporting enterprises to introduce new products (122%), and fostering collaborations between businesses and research institutions (159%). The only shortfall was in employment increase in supported enterprises (91%), though its long-term impacts were expected to extend beyond the project's official timeline, which was echoed by its partners in post-project investigations.

AgorIP delivered strong results against its East Cymru indicator targets, meeting or exceeding six out of eight (See Table 2.). Notable achievements included providing non-financial support to enterprises (138%), securing private investment to match public RD&I funding (129%), supporting new enterprises (100%), helping businesses introduce new-to-market products (210%), introducing new-to-firm products (140%), and fostering collaboration between enterprises and research institutions (133%). However, it fell short in patents registered for products (73%) and employment increase in supported enterprises (38%), largely due to the challenges that had arisen in developing operations in East Cymru post-COVID-19. It is also important to note that patent processes can take several years, as such, there were likely to be processes initiated during AgorIP that progressed post-project (Gov.uk, 2025).

It is also worth noting the non-indicator impacts of AgorIP, such as GIG Cymru UHB's utilising the project as the "go-to" option for commercialisation and IP expertise and advice, especially so after the introduction of the secondees into those organisations. Notable suggestions for the project included higher levels of support quickly and flexibly, operations utilising the expertise of multiple HEIs rather than being based around one, and training for early-stage founders.

Table 1: AgorIP Indicators – West-Cymru and the Valleys

Indicator	Project Target	Project Achievement (June 2023)	% of Total Target Achieved
Number of patents registered for products	68	70	103
Enterprises receiving non-financial support	80	90	113
Employment increase in supported enterprises	50	45.38	91
Private investment matching public support for RD&I projects	£1,136,664	£2.104,336	185
Number of new enterprises supported	20	21	105
Number of enterprises supported to introduce new to market products	55	67	122
Number of enterprises supported to introduce new to firm products	55	61	111
Number of enterprises cooperating with supported research institutions	58	89	153

Table 2: AgorIP Indicators – East Cymru

Indicator	Project Target	Project Achievement (June 2023)	% of Total Target Achieved
Number of patents registered for products	11	8	73
Enterprises receiving non-financial support	13	18	138
Employment increase in supported enterprises	8	3	38
Private investment matching public support for RD&I projects	£100,000	£129,000	129
Number of new enterprises supported	4	4	100
Number of enterprises supported to introduce new to market products	10	21	210
Number of enterprises supported to introduce new to firm products	10	14	140
Number of enterprises cooperating with supported research institutions	15	20	133

5. Celtic Advances Life Science Innovation Network (CALIN)

The Celtic Advances Life Science Innovation Network (CALIN) was a cross-border project between HEIs and Research Institutes in Cymru and the RoI that strengthened collaborative opportunities between the two countries' Life Sciences sectors. CALIN, alike AgorIP in its technology transfer and innovation objectives, differed in its focus on the Life Sciences and joint academic-private research operations. CALIN's research element provided Life Sciences innovation skills and knowledge to SMEs to conduct research projects that covered themes such as Regenerative Medicine, Therapeutics, Biocompatibility & Safety Evaluation, Biosensors & Devices, and Health & Wellbeing (CALIN, 2025). CALIN was an exemplar of open innovation-based RIS support projects, reaching past geographical boundaries to create cross-border RIS collaboration, sharing risks, expertise, and developing innovations and research that could benefit both systems and encourage future collaborations.

CALIN and AgorIP's total impacts were likely to have extended far beyond their initial project lifespans and expected scope, thus they cannot be attributed solely to their original KPI outputs. This notwithstanding, CALIN delivered strong outputs compared to its objectives (See Table 3.): enterprises receiving non-financial support (87%), enterprises cooperating with research institutions (117%), enterprises introducing new-to-market products (143%), enterprises introducing new-to-firm products or processes (84%), and enterprises participating in cross-border, transnational, or interregional research operations (88%). To reiterate the research element of CALIN, it is important to note the 15 publications and 56 additional new-to-firm products created through the project.

Table 3: CALIN Indicators

Indicator	Original Target	Reprofile Target	Achievement as of August 2023	% of Reprofile Target Achieved
Number of enterprises receiving non-financial support	241	241	209	87%
Employment increase in supported enterprises	21	35	36	103%
Number of enterprises cooperating with research institutions	36	60	67	112%
Private investment (Euros) matching public support in innovation or R&D operations	588,000	1,038,000	5,049,055	486%
Number of enterprises supported to introduce new to the market products	9	14	18	129%
Number of enterprises supported to introduce new to the firm products/processes	72	96	71	74%
Number of enterprises participating in cross-border transnational or interregional research operations	36	60	51	85%

Indicator	Original Target	Reprofile Target	Achievement as of August 2023	% of Reprofile Target Achieved
Number of research institutions participating in cross-border, transnational or interregional research operations	12	12	6	50%
Number of new or enhanced cross-border innovation networks	1	1	1	100%

6. Analysis

This analysis situates AgorIP and CALIN within Cooke's (2001) Regional Innovation Systems (RIS), specifically exploring Region, Innovation, Network, Learning, and Interaction concepts.

6.1 Region

AgorIP initially targeted regional economic disparities aligned with ERDF objectives in West Cymru and the Valleys (James, Smith, & O'Shea, 2023). Its subsequent pan-Cymru expansion incorporated secondees strategically placed within Cymru's HEIs and GIG Cymru University Health Boards, significantly enhancing its regional responsiveness. Conversely, CALIN fostered cross-border collaboration between Cymru and the RoI, demonstrating the value of transnational RIS frameworks in avoiding regional isolation or lock-in, as cautioned by Tödtling and Trippl (2011).

Both projects highlighted the strategic advantage of pooling institutional expertise and capabilities to avoid external resource dependencies, evident in CALIN's internal capability utilisation compared to occasional external commissioning observed within AgorIP (James & Smith, 2023).

6.2 Innovation

AgorIP effectively utilised an open innovation model, converting academic and healthcare-generated intellectual property into market-ready innovations, thereby significantly enhancing regional private investment (James, Smith, & O'Shea, 2023). CALIN similarly drove innovation through structured academic-industry collaborations within life sciences, particularly excelling in generating innovative products and attracting substantial private sector engagement (James & Smith, 2023).

6.3 Network

Both projects established extensive collaborative networks. AgorIP connected multiple stakeholders including SMEs, HEIs, and GIG Cymru, effectively using secondments to reinforce stakeholder relations and regional embedding (James, Smith, & O'Shea, 2023). CALIN's cross-border networks effectively facilitated resource-sharing, significantly strengthening collaboration between Cymru and Irish institutions, thus enhancing collective innovation capacity (James & Smith, 2023).

6.4 Learning

AgorIP emphasised practical knowledge transfer, especially in commercialisation and IP management, through direct mentorship and tailored resources, responding effectively to the needs of SMEs and health sector participants (James, Smith, & O'Shea, 2023). CALIN's structured approach to joint research significantly boosted SME capabilities through direct participation in advanced life sciences projects, complemented by wide dissemination through academic publications (James & Smith, 2023). Both projects suggest potential enhancements via digital platforms, which could sustain learning beyond project lifecycles.

6.5 Interaction

Interaction was integral to both projects. AgorIP's structured "Health Hacks" and secondment-based approach fostered meaningful stakeholder engagements, although certain administrative complexities and repetitive initial communications remained a challenge (James, Smith, & O'Shea, 2023). Similarly, CALIN successfully encouraged robust cross-sector interactions through clear communication strategies, though it too faced administrative and communication inefficiencies (James & Smith, 2023). Implementing streamlined ICT systems could address these recurrent issues effectively in future RIS initiatives.

7. Discussion

7.1 Cymru's ERDF Experience: AgorIP and CALIN as Exemplars

AgorIP and CALIN exemplified effective utilisation of ERDF funding, significantly advancing Cymru's Regional Innovation System. AgorIP's shift from regional to pan-Cymru operations exemplified strategic adaptability, enabling broad and effective innovation support across sectors, particularly health and SMEs (James, Smith, & O'Shea, 2023). CALIN further extended these benefits internationally, underscoring the advantages of cross-border collaboration (James & Smith, 2023).

7.2 Project Outcomes: Successes and Areas for Improvement

Both AgorIP and CALIN achieved substantial successes in innovation metrics including private sector investment, new-to-market products, and academia-industry partnerships. AgorIP notably exceeded collaboration and private investment targets, validating its innovation support model (James, Smith, & O'Shea, 2023). Similarly, CALIN demonstrated exceptional outcomes in generating international collaborations and significantly surpassed private investment goals (James & Smith, 2023).

However, notable shortfalls in employment outcomes, especially within AgorIP's East Cymru operations, indicate the need for strategic refinements. Additionally, recurrent administrative and communication issues were significant in both projects, exacerbated by complex procedures and unclear stakeholder expectations. AgorIP's single-institution structure further limited collaborative potential, suggesting the necessity for improved institutional collaboration in future strategies.

8. Recommendations for Future Innovation Support Strategies

Future RIS projects should integrate successful elements, cross-institutional collaboration and robust private sector engagement, whilst addressing identified administrative inefficiencies. A consortium-based approach involving multiple Cymru universities, structured with a "first among equals" leadership model, such as that with CALIN, could significantly enhance regional coherence, reduce duplication of efforts, and lower costs through utilising each individual HEI's capabilities more effectively. This collaborative structure could also strengthen the competitive position of Cymru's HEIs for securing post-Brexit UK innovation funding (Universities Wales, 2023).

Additionally, the adoption of an advanced ICT platform as a digital 'shopfront' could be integral to future RIS initiatives. This platform could significantly streamline stakeholder interactions, simplify administrative processes, and enhance project transparency, particularly benefiting SMEs and microbusinesses central to Cymru's business landscape.

9. Conclusion

The insights from AgorIP and CALIN demonstrate that future RIS initiatives in Cymru must prioritise institutional collaboration, simplified administrative structures, and integrated digital communication systems. Addressing these strategic areas effectively could substantially enhance regional innovation capacity, resilience, and competitiveness, aligning closely with Llywodraeth Cymru's vision for a more dynamic and inclusive innovation ecosystem (Welsh Government, 2023).

Ethics Declaration

Ethical clearance was not required for this research paper.

AI Declaration

AI was used to grammar and spell check this research paper.

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A Possible Way to Enhance European Competitiveness

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Abstract: In our Conference presentation, we would like to present a possible way to enhance European Competitiveness, which is registered in the Hungarian Intellectual Property Office under the name of the "IK & International Innovation Center" Project. (Voluntary registration number: Y2500012)**.** In the introductory part, our previous research results – primarily related to Library Innovation, generating creativity and startups and the associated social media platform – will be briefly presented. In our presentation, we will also discuss the results of university students' responses to online questionnaires related to this topic. The International Innovation Center Project (IICP) aims to increase the competitiveness of the EU by establishing an International Innovation Center, which would be implemented in the capital of an EU member state, with the participation of all EU countries. Some main parameters: in the 27-story "Metropolis", each EU member state would have its own floor – research lab, mini innovative exhibition area, luxury apartment – as well as a "common" innovative Startup centre (permanent interactive exhibition open to both professionals and the general public), a common, high-tech equipped, ergonomic, library research and development lab including Coworking elements, an international conference centre, a cultural and sports centre, an Innovation Park with a helipad. The Project would be an investment of a similar volume to the MOL Campus in Budapest. **I**n the conclusion, we outline the research directions that will generate further innovation.

Keywords: Competitiveness, EU Innovation Tower, Research Lab, International Exhibition, Conference Centre, Library Innovation

1. Introduction, Research Background

Our research topic: "Electronic library services in the 21st century". We carried out our research by studying and analyzing the integrated library systems of 19 county libraries, 65 higher education libraries and 39 university libraries in the USA – using inductive and quantitative methods – primarily with the help of the Internet. (Ferenc, 2017), (Iszály, 2014)

The practical implementation of our research results, according to the experiences so far – one of the defining goals and directions of which is the promotion of innovation and creativity in university and public libraries – could significantly compensate for the negative tendencies of the digital revolution on libraries. (Ágnes, 2023)

Libraries are unable to maintain their previous position due to the widespread use of E-book readers, Google books, E-libraries, and smartphones, therefore are at a disadvantage.

One of the results of my PhD research (our research) is the UnInLib system. (Ferenc, 2022)

The purpose and importance of my UnInLib system: The UnInLib system is intended to create the "Library Innovation Ecosystem". Its primary purpose is to implement and apply a new, closed Web-based service system primarily for university libraries – domestic and international – that facilitates the creation, development and implementation of innovation and Startup ideas and inventions of university students, lecturers, graduates, and professionals participating in dual training. The central part of UnInLib is the Web Innovation Library Knowledge Base (WIKT) software system, which is a new library portal with a structure similar to Linkedin and Facebook. (Ferenc, 2018)

The system provides all the information and assistance for starting and running a successful innovative enterprise: Startup information, Online courses, Startup Problems database, Ideas database, Professional database, Professional dating, creating new Startups, ensuring the conditions for online and offline meetings. Through the GenILib subsystem, it supports the innovation efforts of public libraries in several areas, the main functions of which are: value preservation, value creation, library Coworking, exhibition, online applications, skill development competitions, forums, blogs, online opinions, rankings, organization of modern electric means of transport in a library environment, library tourism.

Benefits of using the UnInLib system.

- Helping libraries to increase their participation in research, innovation, and the adoption and implementation of university Startup ideas.
- Involving university students in innovation and arousing interest in inventions.
- Playing a motivating, catalytic, and inspiring role.

- Promoting the discovery of new inventions.
- Supporting university students, lecturers, graduates, and professionals participating in dual training to jointly carry out developments, research, and possibly apply for joint applications.
- Helping to conceive and implement inventions and Startup ideas.
- Support for the formation of professional groups with the help of the Professional Partner Search and the Professionals database.
- Increase in the number of inventions and Startup ideas with the help of the Problems database and Ideas database.
- Concentration of a large amount of innovation potential by registered students, lecturers, graduates and researchers participating in dual training of domestic and international university libraries.
- Significant reduction in the implementation time of inventions and Startup ideas from idea to exit by WIKT.
- Arousing the interest of university students and future students in inventions with the Startup exhibition.
- The Startup subject promotes the birth of Startup ideas, the formation of professional groups and developments, and the Startup lab promotes experimentation and practical implementation.
- The system also supports the process of becoming a Startup entrepreneur. (Iszály, 2016)

Patent: The invention of our research, which is also implemented in practice: “New innovative electronic service system for libraries” – is under patent protection based on the acceptance statement of the Hungarian Intellectual Property Office (Case No.: P2000283).

The Hungarian Patent and Trademark Gazette published our patent application on March 28, 2022. (Iszály, 2022)

The need for the UNINLIB system is supported by the results of online questionnaires conducted among university students:

Distribution of answers to the Startup question

Would you consider it to be advantageous and support a “University Startup” service for the university library? (Figure 1.)

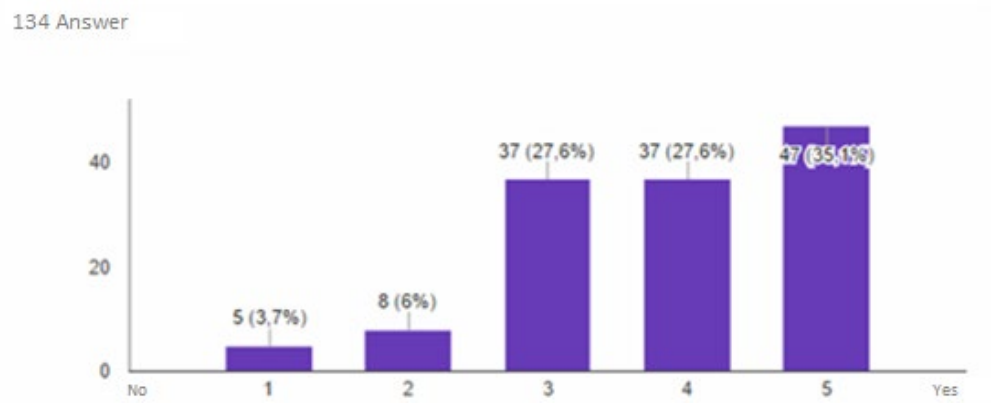


Figure 1: University Startup service

The scale ranges can be interpreted as follows:

1 – I strongly disagree

2 - I disagree

3 - Neutral/neither agree nor disagree

4 – I agree

5 – I strongly agree

It is very important that the vast majority of students require the Startup service of university libraries.

At the international level, joint developments, research, the WIKT system, the database of professionals, the professional matchmaker, the database of problems, the ideas, the Library Coworking, greatly promote international innovation, the effective practical implementation of ideas, and the enhancement of European competitiveness. (Figure 2.)

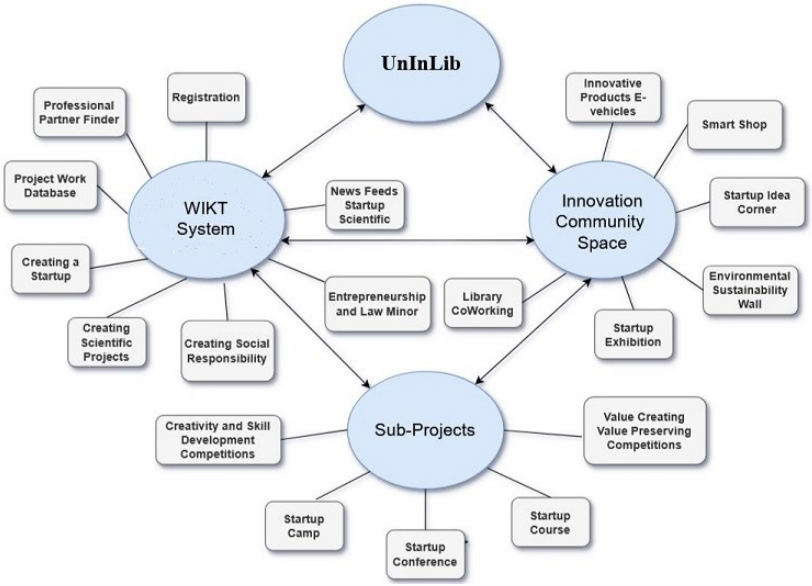


Figure 2: Structure of the UnInLib system

2. The International Innovation Center Project (IICP)

Objective: to enhance the competitiveness of the EU by establishing an International Innovation Center, which according to the plan would be implemented in the capital of an EU member state, for example Budapest, with the participation of all EU countries. Some main features: in the 27-storey “Metropolis”, each EU member state would have its own floor – research lab, mini innovative exhibition space, luxury apartment – as well as a “common” innovative Startup centre (permanent interactive exhibition open to both professionals and the general public), a common, high-tech equipped, ergonomic, library research and development lab including Coworking elements, an international conference centre, a cultural and sports centre, an Innovation Park with a helipad, and an Innovation Hotel. The Project would be an investment of a similar volume to the MOL Campus in Budapest. (Figure 3.)



Figure 3: MOL Campus (MOL, 2025)

https://www.iguzzini.com/projects/project-gallery/mol-campus/

The relevance of the IK & International Innovation Center Project is timely in several ways:

"European competitiveness is undergoing a serious decline", "Europe needs a competitiveness turnaround", "The Hungarian EU Presidency (2024.07.01 – 2024.12.31) therefore placed great emphasis on European competitiveness: the growth and innovation gap between the Union and its competitors must be reduced"

(In the Hungarian Intellectual Property Office, the "IK & International Innovation Center" Project voluntary work registration number: Y2500012)

Main units of the IK & International Innovation Center (Figure 4.)

The locations at the Innovation Center:

- National units of the EU Innovation Tower, each EU country's own floors in the 27-story Innovation Tower: luxury apartment, home office, mini exhibition.
- Joint High-Tech Research Laboratory
- International Exhibition Unit, Community Space, Restaurant
- International Conference Centre, Conference Exhibition, Restaurant
- Innovation Library (Library Coworking, Virtual Library Elements)
- Sports, Cultural Centre, Theatre, Cinema
- Innovation Park
- Helicopter Landing Site
- Innovation Hotel (5-star)



Figure 4: NIC Vision Plan

Operation, brief description, main features

- Each country will own one floor of the 27-story "Metropolis", select the most innovative market-leading company of its nation, provide for the high-tech equipment of its own floor, the innovative equipment of its own space in the International Exhibition Unit, and its continuous renewal. Of course, it can use the common areas and opportunities on a subject-right basis: research lab, exhibition, conference, library, cultural centre, innovation park. (The property can be sold, transferred, inherited)
- The Research Lab greatly facilitates the planning and implementation of innovative joint projects
- The International Exhibition is open to both professionals and the general public
- Annual local Innovation Conference with exhibition
- Biennial international Innovation Conference with exhibition
- Each EU country organizes its own exhibitions presenting its innovative products
- In the case of national investment, assets, the given country has ownership rights and utilization

2 main characteristic features of the IK & NIC Project

- Total area requirement of the Project: ≈34000 m2 ≈3.4 ha

- Total planned cost of implementing the IK & International Innovation Center (Management, planning, land ownership, utilities, sustainability, technical implementation, high-tech equipment of objects, smart solutions): ≈ 85 M euros.

Some implementation options:

- In cooperation with the EIT (European Institute of Innovation and Technology)
- With the involvement of the governments of the EU countries
- From the research budget of the EU countries
- With the participation of the most innovative market-leading companies of the EU countries
- With the involvement of large investors, banks ("Innovation Science Center Plaza")
- With the participation of EU Research Institutes
- With the involvement of the richest people in the EU TOP 100
- With EU grant funding

Within this framework, a brief description of 3 locations – International Exhibition, Innovation Community Space, Smart Cabin – will be given.

2.1 International Exhibition Subproject

Aim: To present the great inventions of humanity from ancient times to the present day with interactive elements and working models. EU and Hungarian inventors, Startups, the process of implementing ideas, and the role of creativity in coming up with discoveries will be given a prominent role. At the exhibition, every visitor has the opportunity to test their various abilities. The exhibition's goal is not to draw attention to creation, to provide inspiration – primarily for the younger generation – to come up with ideas and to implement them in practice. Visitors will learn – with the help of 3D online films and videos – the importance of the most successful Startups, the main stages of the path to success, and their "development history". In the case of school groups, there is an opportunity for an ad hoc "ideas exchange", online evaluation and awarding of ideas. There is an opportunity to take digital online photos with "Explorers, Scientists" and send them to your own email. Another important goal is to provide new Startups with an opportunity to introduce themselves, test them, and present a library Coworking.

Topics: Significant discoveries, world inventions. Ideas, interesting things. Domestic inventions. International Startups. Domestic Startups. Startup, optimization tasks. Creativity development trainings. Completed Startups. Interactive presentations. Student Startup presentations. (Tóth, 2023)

Informatics, technical implementation: Exhibition of the history of inventions. Digital boards. Digital picture frames. Digital online photo creation. Interactive boards. Working models. Film screening (3D). Interactive exhibition, presentations. Simulators. Online creativity development training. Computer skills testing, measuring, developing online programs (Attention, Memory, reflex, speed of thinking, creativity... short competition for groups, announcement of results, awards). Digital "lecture" about Startup.

2.2 Innovation Community Space

(Boutiller, 2020)

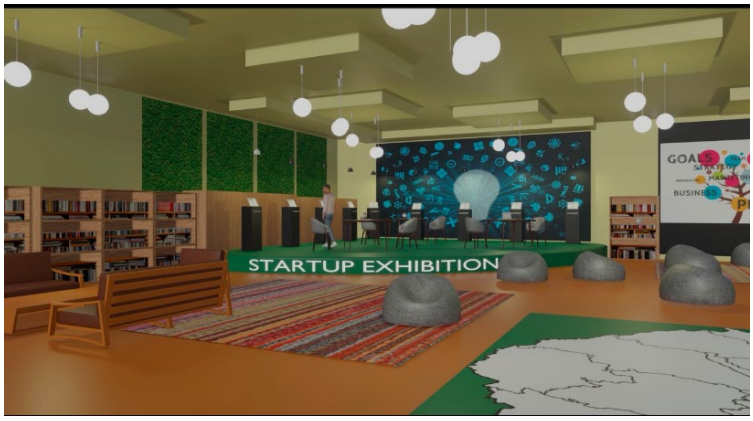


Figure 5: Coworking Startup Exhibition

Aim: Creating innovation spaces that sufficiently increase efficiency, creativity and innovation, focusing on the ever-increasing digital social demand, creating a working environment for those working online and those engaged in inspiring work. Recommendation on the aspects of creating an ideal Coworking office. Helping with a startup camp. The goals of the Coworking office include assisting in the physical implementation of projects, as well as the possibility of testing and validating them. The UnInLib system would not only provide assistance to innovative users in the virtual space, but also in physical implementation. (Figure 5.)

2.3 Smart Cabin (Mini Medical Diagnostic Lab)

Aim: The primary aim of the IK & Smart Cabin is to provide a separate – sound, heat-insulated, ergonomic (chair, keyboard, mouse…) design space in libraries, educational institutions, air and rail waiting rooms, VIP railway carriages, local governments, catering units, cultural and healthcare institutions, and racetracks, where you can make phone calls, participate in video conferences, distance learning, do home office work, and enjoy diverse, safe, smart solutions that can be brilliantly utilized in everyday life, and at the same time have educational value. The three main characteristics of innovation must be fully taken into account when designing and creating the Cabin: optimization, efficiency, and sustainability.

Its secondary purpose is to assess the user's health status with the following services:

- Digital blood pressure measurement
- Body composition analyzer/bmi/fat-muscle measurement
- Blood oxygen level measurement
- Respiratory function/asthma monitoring
- Body temperature measurement
- Test strips (urine, blood sugar, triglyceride, cholesterol, uric acid)
- General condition assessment health index measurement
- Mental state, memory, reaction time
- Hearing status measurement
- Superficial inflammation check (thermography/medical infrared camera)
- Resuscitation device (aed/defibrillator).

The main units, modules, functions, and options of the Smart Cabin:

(In the Hungarian Intellectual Property Office, the "IK & Smart Cabin" Project voluntary work registration number: Y2500143)

3. Summary

The IK & International Innovation Center Project: the EU Innovation Tower, the Research Lab, the International Exhibition, the International Conference Center, the Innovation Library, the Sports and Cultural Center, the Innovation Park, the Innovation Hotel - with its creation and practical operation, can provide an ideal environment for the EU's leading "innovators", which will greatly promote the competitiveness of the EU, the reduction of the growth and innovation gap between the Union and its competitors, as well as Innovation and AI research. (Kristóf, 2025)

3.1 A Small Digression: Briefly About our Family Research Company

From 2021, our main area of activity within the framework of Innov Research Institute Ltd. is research, the defining direction of which is innovation. (figure 6., 7.)

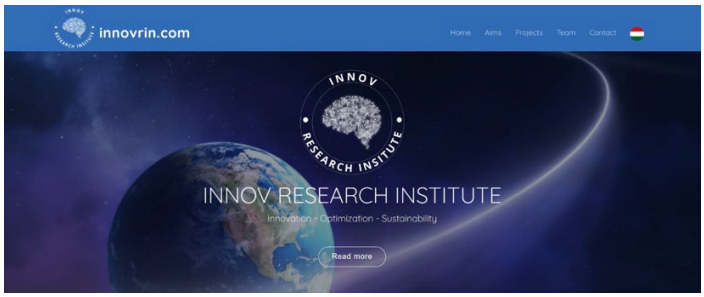


Figure 6: Our website

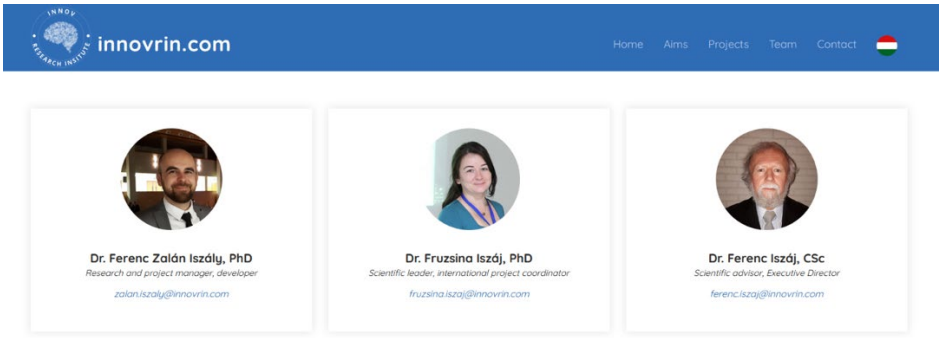


Figure 7: The team

Universal goals: Our general aim is to research innovation, implement innovative projects, and teach its methods. Our main goal is to further research library innovation, to implement the results so far – our UnInLib system – in practice at the domestic and international level. Another purpose is to prepare innovation studies, plans, projects for the business community and the public sector and to assist and coordinate their implementation. In all these goals, the key aspects are innovation, optimization, efficiency, economy, health protection, and sustainability. Our goal is also to scientifically examine innovation and successful startups from a psychological perspective.

The “general” formulation of innovation – according to our interpretation – is:

“Innovation is continuous innovation, development, creative problem solving, a universal phenomenon where the goal is more efficient implementation.”

The innovation motto, “Ars poetica” of the Innov Research Institute:

“Innovation should be optimal, efficient, energy-saving, value-preserving, and environmentally friendly.” (Deák, 2023)

3.2 In Conclusion

In order to implement projects as soon as possible, the Innov Research Institute plans to launch the following

Call for Proposals: The Innov Research Institute is looking for "Multi-investor" for the practical implementation of the following 3 projects.

3.2.1 International Library Innovation Project

The aim is to conduct further researches on library innovation and to put the results of the UnInLib system into practice at national and international level (this project has been published as an invention in the Bulletin of the National Intellectual Property Office, with the patent number P2000283). The importance of the project is reflected in the fact that there are 2.8 million libraries worldwide having more than 1 billion library card holders. The current research focus is the implementation of the International Virtual Library in the ”Cloud” with innovative library services suitable for the 21st century.

3.2.2 IK & International Innovation Centre Project

The International Innovation Center Project (IICP) aims to enhance the competitiveness of the EU and Hungary by creating an International Innovation Center, which is planned to be located in Budapest and would be implemented with the participation of all EU countries. Some of the main parameters are the followings: in the 27-storey "Metropolis" each EU Member State would have its own dedicated floor - research lab, mini innovative exhibition space, luxury apartment - plus a common innovative Startup Centre (a permanent interactive exhibition open to both professionals and the general public), a common research and development lab with high-tech equipment, ergonomic library coworking elements, an international conference centre, a cultural and sports centre, an Innovation Park with helipad. This project would be an investment of similar scale to the MOL Campus.

3.2.3 IK & Smart Cabin Project

The primary objective of the IK & Smart Cabin Project is to provide - in libraries, educational institutions, air and rail lounges, VIP carriages, municipalities, catering facilities, cultural and health institutions, race tracks, customer services of leading service providers - a separate (sound, heat insulated, ergonomic, high-tech equipment and furnishings with excellent acoustics) design space, where it is possible to make phone calls, participate in video conferences, distance learning, home office, secure banking, and enjoy a wide range of innovative, smart solutions that are both highly practical in everyday life and have educational potentials - health, skill-building, entertainment, relaxation - in an uninterrupted and ideal environment.

3.2.4 Application Conditions

The volume of participation in the Projects – the investment, the consideration for the ownership share – is at least 2M euros. For a part of the invested amount, the investor acquires a share of ownership in the Projects. In case of serious intention and interest, we will hold a Project presentation at the given location.

3.2.5 Company Information

You can find out more about Project 3 at the following website: www.innovrin.com

3.2.6 Application Method

We welcome applications from investors with strong capital, by sending a short Company Profile electronically to: zalan.iszaly@innovrin.com

3.3 Finale, Closing

In summary: The International Innovation Center, with its research labs, Startup Center, local and international exhibitions, conferences, 21st century Library Coworking and the international virtual library implemented in the cloud, can be a very effective, excellent, exemplary field for innovative joint research, the implementation of new projects and inventions, and can play a catalytic role in dynamically enhancing the competitiveness of the EU. As a synonym for the US Silicon Valley, the 21st century “EU International Innovation Metropolis” could be realized.

Ethics Declaration

Not relevant to the paper.

AI Declaration

The paper used AI (Canva) in a form in Image 3: NIC Vision Plan

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Hackathons as a Method for Fostering Corporate Innovation and Competitive Advantage

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Abstract: Hackathons, originally rooted in the software and technology sectors, have evolved into powerful tools for corporate innovation. Today, organizations across diverse industries use them to accelerate idea generation, boost employee engagement, and strengthen competitive positioning. However, despite their growing popularity, the mechanisms by which hackathons drive innovation within firms remain underexplored in academic literature, particularly from the standpoint of innovation theory and strategic management. Much of the existing research is fragmented across disciplines such as healthcare, education, and computer science, lacking a unified framework for understanding hackathons as instruments of organizational innovation. This study addresses that gap by examining hackathons as structured innovation development mechanisms. Drawing on a comprehensive review of scholarly sources, we investigate the definitions, theoretical foundations, and practical implementations of corporate hackathons. The paper develops a conceptual model that delineates the phases, design components, critical success factors, and post-event integration processes necessary to foster sustainable innovation outcomes. Our findings suggest that hackathons support corporate innovation by enabling rapid experimentation, attracting entrepreneurial talent, and cultivating internal knowledge-sharing communities. Moreover, they provide a low-risk environment conducive to intrapreneurship and openness to change. This article contributes to the academic discourse on innovation and organizational learning by situating hackathon practices within strategic innovation frameworks. It also offers actionable insights for practitioners on how to effectively design, implement, and leverage hackathons to drive competitive advantage in dynamic and uncertain business environments.

Keywords: Corporate Hackathon, Hackathon Methodology, Innovation Management, Competitive Advantage.

1. Introduction

In today's rapidly evolving business environment, corporations are under increasing pressure to innovate at speed, adapt to uncertainty, and attract agile talent. Hackathons, time-bounded, challenge-based innovation events, have emerged as a strategic response to these demands. Originally associated with the tech and software sectors, hackathons are now being repurposed within large organizations as tools for stimulating internal innovation, uncovering latent expertise, and building agile organizational capabilities (Granados et al., 2019).

Corporate hackathons differ from traditional innovation initiatives by emphasizing speed, creativity, and cross-functional collaboration under intense time constraints. Their value extends beyond immediate outputs; they contribute to knowledge exchange, employee engagement, and even corporate branding. Recent research highlights individual benefits such as skill development, career progression, and expanded professional networks (Pe-Than et al., 2020; Ulfsnes et al., 2021), alongside organizational gains like faster prototyping, team synergy, and expert community building. Moreover, there is growing evidence that newly formed hackathon teams tend to generate more novel solutions than pre-existing teams, often venturing beyond conventional work boundaries (Pe-Than et al., 2020).

Despite their rising popularity, hackathons remain a relatively under-theorized phenomenon in organizational studies. Questions persist regarding which structural, cultural, and strategic elements make corporate hackathons effective - not just as creative exercises, but as mechanisms for sustainable innovation and long-term competitive advantage. Scholars have noted the lack of systematic frameworks that connect hackathon design with strategic outcomes, including the integration of post-hackathon projects into the organizational product portfolio (Ulfsnes et al., 2021; Briscoe et al., 2014).

This study addresses this research gap by conducting a comprehensive review of the scientific literature on corporate hackathons. The aim is to identify and analyze the critical success factors that enable hackathons to function as high-impact innovation platforms. Special attention is given to the specific elements of hackathons as a structured methodology for driving innovation and creating competitive advantage. The insights derived

from this review serve to construct a structured methodology that organizations can apply to design and implement hackathons aligned with their innovation goals.

The paper is structured into five sections. The first section synthesizes the existing literature, focusing on definitions, typologies, benefits, and core characteristics of hackathons. The second section outlines the research methodology. The third presents the findings of the literature review. The fourth section discusses the key factors contributing to successful hackathon implementation in corporate environments and proposes a conceptual framework. The final section concludes with practical recommendations and directions for future research.

2. The Theoretical Background of Research

Hackathons are commonly defined as time-limited, solution-oriented events that bring individuals together to collaboratively address specific problems or challenges (Saleh et al., 2025; Chowdhury, 2012). Originally conceived as programming events, they typically involve small teams of volunteers working intensively over a short period - often 24, 36, 48, or up to 72 hours - to develop software prototypes or other creative solutions (Kienzler et al., 2017; Li et al., 2015; Richard et al., 2015). In the context of information technology, hackathons are specifically understood as collaborative programming marathons focused on rapid prototyping (Lara et al., 2016). As Briscoe and Mulligan (2014) note, the essence of hackathons lies in their capacity to bring people together around a common challenge, fostering innovation through structured, time-bound collaboration.

Corporate hackathons have emerged as a valuable strategy for software companies to foster innovation, improve products, and build ecosystems. These time-bounded events bring together teams to collaborate intensively on projects, generating new ideas and prototypes (Tran et al., 2025; Valença et al., 2020; Ei Pa Pa Pe-Than et al., 2020). Research has identified various benefits of corporate hackathons, including skill development, career advancement, and networking opportunities for participants (Ei Pa Pa Pe-Than et al., 2020). Successful hackathon projects often focus on developing functional prototypes aligned with existing products and customer needs (Leemet et al., 2021). The sustainability of hackathon outcomes depends on factors such as team composition, project preparation, and organizational support (Leemet et al., 2021). Furthermore, corporate hackathons can contribute to the growth of software ecosystems by facilitating open innovation and platformisation processes (Valença et al., 2019). Overall, hackathons serve as alternative modes of production and innovation, offering social, technical, and business benefits to participating companies (Valença et al., 2019).

3. Research Methodology

This study employs a qualitative, integrative literature review to develop a comprehensive understanding of how hackathons function as methodological instruments for fostering innovation and competitive advantage within corporate environments. An integrative review approach was selected due to its suitability for synthesizing diverse types of scholarly work, including empirical studies, conceptual frameworks, and theoretical analyses, thereby enabling a multidimensional exploration of hackathon practices in organizational contexts.

This study follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure transparency, reproducibility, and methodological rigor in the literature selection and analysis process (Figure 1) (Posso Pacheco et al., 2025). A systematic search was conducted using two leading academic databases, Scopus and Web of Science, covering publications from 2020 to 2025. The PRISMA approach guided the identification, screening, eligibility assessment, and inclusion of relevant studies. The initial search yielded 504 records, which were screened for relevance following the removal of duplicates. Based on predefined inclusion and exclusion criteria, a total of 17 articles were selected for qualitative synthesis. The search strategy was constructed around the following Boolean query: "Corporate hackathon" AND "Innovation".

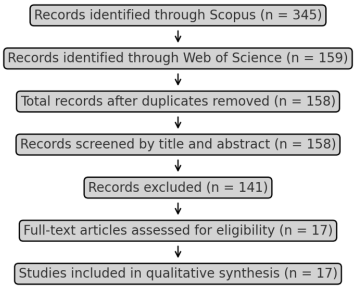


Figure 1: PRISMA Flow Diagram for Hackathon Literature Review

The inclusion criteria for article selection required that sources be published in English, peer-reviewed and open-access, and directly address digital or innovation-driven organizational methodologies, with a particular focus on hackathon-related strategies. Articles were excluded if they focused solely on physical branding without incorporating innovation or digital components, or if they offered only general managerial commentary lacking methodological depth.

Following a systematic screening process - including title and abstract review, full-text screening, and relevance evaluation - a total of 17 high-relevance articles were selected from an initial pool of 158 shortlisted studies. These articles were chosen based on their methodological rigor, theoretical contribution, and relevance to the core themes of innovation processes, intrapreneurship, and agile strategy development through hackathons.

The final synthesis integrates insights from these selected studies to distill the structural elements, critical success factors, and organizational outcomes associated with corporate hackathons. This methodological approach ensures that the findings are grounded in a robust scholarly foundation while offering implications relevant to both academic discourse and managerial practice.

4. Results

The structured framework derived from the integrative review reveals not merely a checklist of hackathon components, but a window into how organizations increasingly seek to engineer creativity, engagement, and strategic agility through codified innovation processes. This evolution - from spontaneous tech sprints to strategically curated corporate interventions - marks a paradigmatic shift in how firms pursue innovation capability development. However, several deeper insights and tensions emerge upon close inspection of the framework.

Table 1: Key Methodological Elements of Corporate Hackathons Across Lifecycle Stages

Hackathon Lifecycle stage	Element	Definition	Authors
Before hackathon	Identification of objectives	Innovation creation	Heller et al., 2023; Nolte et al., 2020
		Connect to early adopters	Di Fiore, 2013
		Learning organization	Schulten et al., 2024; Hogan, M. 2022
		Corporate branding	Uffreduzzi, 2017
		Talent engagement & recruitment	Trainer et al., 2016
		Team building and collaboration	
	Identification of challenges and problem statement	Technology focus challenge	Heller et al., 2023; Angarita et al., 2020; Briscoe 2014
		Nontechnology focus challenge	
	Type of Hackathon	Virtual	Bertello et al., 2022; Paganini et al., 2020
		Physical	
		Hybrid	
	Background of participants	Tech background teams only	Beck et al., (2020), Pe-Than et al., 2020; Banal-Estañol et al., 2019
		Mixed teams with various backgrounds	
	Team formation	Formation before hackathon	Nolte et al., 2018
		Formation on hackathon day	Porras et al., 2021
	Selection of jury and mentors	Experts from industry	Chala et al., 2024; Nolte et al., 2020
		Academicians	
	Secure funding	internal budget allocation	Folk et al., 2024; Granados et al., 2018
		sponsorship models	
		stakeholders buy-in	
	Prizes	Financial	

Hackathon Lifecycle stage	Element	Definition	Authors
		Nonfinancial	Folk et al., 2024; Granados et al., 2018
Execution	Opening ceremony, Rules and kick off	Event kickoff and expectations setting	Aryana et al., 2019; Panchapakesan et al., 2019; Karlsen et al., 2017
	Mentorship	Guidance from internal/external experts during event	Chala et al., 2024; Nolte et al., 2020
	Jury assessment and voting	Evaluation by panel or public; selection of winners	Milićević et al., 2024
	Networking	Informal/team collaboration sessions	Folk et al., 2024; Feder, 2021
Post Hackathon	Follow up and support programs	Project incubation, internal scaling, continued support	Kamariotou et al., 2022; Chan et al., 2020

Source: authors' creation

What is striking in the aggregated elements is the lack of theoretical cohesion. While individual studies articulate operational components (e.g., team composition, mentor engagement), they rarely trace a mechanistic logic connecting design elements to measurable innovation or competitive outcomes. For example, is the presence of cross-disciplinary teams a proxy for absorptive capacity? (Zahra et al., 2002). Do different jury structures (expert vs. popular vote) affect legitimacy and knowledge diffusion? The field currently lacks robust explanatory models that bridge design choices with outcomes via established innovation theory.

This gap underscores a need for mid-range theories tailored to the hackathon context—ones that can link event design to strategic innovation outcomes through mediators such as organizational learning, psychological safety, or knowledge recombination.

Another under-theorized yet promising perspective is to conceptualize hackathons not just as innovation events, but as dynamic capability-building mechanisms. Seen this way, they do not simply produce ideas—they cultivate an organization's ability to sense opportunities, mobilize knowledge, and reconfigure internal resources (Teece, 2007). However, this view requires reorienting hackathon success metrics away from winning ideas and toward indicators of organizational learning, cross-functional collaboration, and post-event project adoption.

Surprisingly, the reviewed literature devotes little attention to how organizations absorb, scale, or institutionalize hackathon outputs, reinforcing a fragmentation between micro-level activities and meso/macro-level strategic capabilities.

A critical weakness in the current literature - and mirrored in the framework - is a bias toward event-time thinking. Much of the academic and practical focus is preoccupied with designing the "perfect" hackathon. Yet, innovation is not bounded by 48 hours. Without clear mechanisms for post-event integration, incubation, or portfolio alignment, hackathons risk becoming an innovation theatre: performative but strategically hollow (Blank, 2019).

The post-hackathon phase, as lightly treated in the literature, needs significantly more attention. Follow-up programs, internal champions, and governance structures are likely far more predictive of long-term innovation impact than ideation methods alone. The absence of robust studies here is both a research opportunity and a warning flag for practitioners seduced by short-term outputs.

While the framework identifies strategic intent (e.g., branding, recruitment, innovation creation), it stops short of grappling with the tensions inherent in corporate hackathons. For instance:

- What happens when employee-driven ideas conflict with existing product roadmaps?
- How are intellectual property and authorship handled in multi-stakeholder teams?
- Can a grassroots ethos be preserved under top-down, metrics-driven oversight?

These tensions highlight the need for political and cultural analysis of hackathons as embedded organizational processes. Hackathons, in this light, are sites of negotiation—between autonomy and control, creativity and execution, novelty and feasibility. Ignoring these dynamics renders an overly sanitized view of innovation.

Finally, the framework prompts reconsideration of how we evaluate hackathon success. Current metrics—number of ideas generated, participants engaged, or prototypes developed—are necessary but insufficient. High-impact scholarship should push toward multi-dimensional evaluation models that capture:

- Innovation absorption (Are ideas piloted or scaled?)
- Talent development (Do participants grow in entrepreneurial self-efficacy?)
- Cultural change (Does the event shift norms toward experimentation?)

Such models would allow us to link hackathon practice to enterprise transformation, moving from anecdotal enthusiasm to evidence-based strategy.

5. Discussions

This framework (see figure 2) not only fills the theoretical gap in understanding hackathons as innovation infrastructure but also provides a strategic toolkit for organizations seeking repeatable, scalable, and outcome-driven innovation practices.

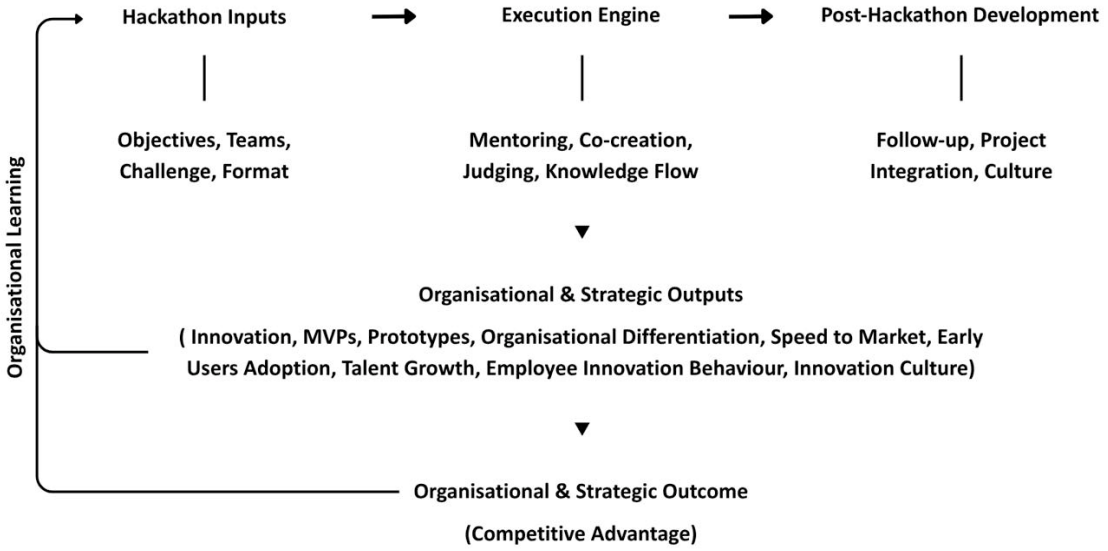


Figure 2: Hackathon Lifecycle Framework for Corporate Innovation and Competitive Advantage
Source: authors' creation

The "Hackathon Inputs" phase reflects the strategic codification of conditions under which innovation can emerge. Drawing on Granados and Pareja-Eastaway (2019), this stage is not merely logistical but intentionally structured to enable ideation aligned with corporate goals. Elements such as the definition of objectives (Heller et al., 2023; Nolte et al., 2020), team diversity (Beck et al., 2020), and the learning culture (Schulten et al., 2024; Hogan, 2022) serve as innovation enablers. These inputs establish the cognitive, social, and technical infrastructure necessary for agile innovation behavior (Pe-Than et al., 2020). Moreover, the identification of strategic problem statements—whether technological or not (Angarita et al., 2020; Briscoe, 2014)—influences the quality of idea generation. From the lens of innovation theory, this phase maps onto Teece's (2007) "sensing" capability, where opportunity recognition is informed by internal and external cues. Thus, this stage serves as a foundation for innovation readiness, influencing all downstream outputs and outcomes.

The execution engine functions as the intensive zone of action, where cross-functional collaboration, mentoring, and real-time knowledge exchange are activated under constraints (Trainer et al., 2016; Karlsen et al., 2017). This stage mirrors what Kolb (1984) describes as experiential learning - learning through doing, observing, and iterating in rapid cycles. Literature supports that hackathon mentoring (Chala et al., 2024; Nolte et al., 2020) and peer learning (Feder, 2021) are central to enabling co-creation. Aryana et al. (2019) also highlights the symbolic function of opening ceremonies and rituals, which signal the event's significance and activate motivation. Moreover, this is the phase where the knowledge flow becomes kinetic, facilitating recombination, experimentation, and feedback loops—core tenets of agile and lean innovation. Execution reflects the "seizing" phase in Teece's framework, where sensing is converted into tangible opportunity pursuit. However, the literature also cautions about trade-offs: Pe-Than et al. (2020) and Ulfsnes et al. (2021) note stress, misaligned

incentives, and coordination barriers, especially in virtual formats, suggesting that the execution phase must be carefully moderated to avoid burnout or disillusionment.

This stage is critically underdeveloped in both practice and literature but is arguably the most strategic. Chan et al. (2020) and Folk et al. (2024) stress that without follow-up mechanisms, promising ideas rarely translate into organizational change. This stage includes incubation, stakeholder buy-in, and alignment with formal innovation portfolios—activities essential for institutionalizing innovation. The lack of systematic structures for idea continuity, as noted by Ulfsnes et al. (2021), exposes hackathons to the risk of becoming an innovation theater. From an organizational learning perspective (Argyris & Schön, 1978), this phase should facilitate double-loop learning, where not only actions but underlying assumptions are revised. Learning theories provide valuable insights into entrepreneurship education, particularly regarding learning styles and opportunity perception (Kakouris & Morselli, 2020; Kakouris et al., 2025). Moreover, the integration of hackathon outputs into existing workflows and governance structures is what allows firms to reconfigure capabilities - mapping onto Teece's "reconfiguring" function. The post-event phase, then, is not the end but the moment of strategic translation, where tactical energy is embedded in long-term strategic assets.

Outputs are the first-order indicators of success and innovation activation. The literature reviewed (Pe-Than et al., 2020; Nolte et al., 2018) consistently emphasizes deliverables such as prototypes, skill development, and increased innovation engagement. These outputs contribute to a firm's innovation capability infrastructure, not just through artifacts but via new behavioral norms and enhanced collaboration fluency. Chala et al. (2024) also document that structured evaluation and academic mentorship contribute to improved entrepreneurial competency among participants. Outputs serve both symbolic and functional roles: they are visible wins that justify investment while also laying down the scaffolding for future knowledge reuse and cultural shifts. As such, outputs can be understood as the micro foundations of dynamic capability, signaling an organization's ability to adapt, learn, and innovate in complex environments.

The final outcome, competitive advantage, is not automatic. It results from the cumulative and integrated effects of the previous stages, particularly when organizational systems capture, scale, and strategically align hackathon outputs. According to Barney's (1991) resource-based view, competitive advantage arises when outputs are valuable, rare, inimitable, and embedded in the firm's systems. Granados & Pareja-Eastaway (2019) show that hackathons can increase organizational responsiveness and brand equity, while Ulfsnes et al. (2021) suggest that consistent hackathon cycles reinforce a culture of innovation. However, outcome realization depends on governance - how leadership, resource allocation, and evaluation are integrated. Without that, competitive advantage remains a theoretical possibility rather than a realized outcome. In this sense, hackathons are not just innovative events - they are strategic instruments that, when holistically managed, can reinforce a firm's position in dynamic markets.

Crucially, the relationship between hackathon outputs, outcomes, and inputs is not linear but cyclical. As organizations begin to internalize the insights, behaviors, and innovations generated during hackathons, these experiences inform and enhance the design of future events. For instance, if post-hackathon evaluations reveal that diverse teams yielded higher-quality, cross-functional solutions (Beck et al., 2020), future hackathons may deliberately engineer heterogeneous team formation as a strategic input. Similarly, the identification of bottlenecks in project follow-through (Ulfsnes et al., 2021) may prompt the inclusion of post-event incubation frameworks or stakeholder buy-in mechanisms as core components in hackathon planning. This recursive feedback mechanism echoes Argyris & Schön's (1978) model of organizational learning, where lessons learned from action inform revised action strategies. It also reflects Teece's (2007) emphasis on reconfiguration as a dynamic capability—firms continuously reshaping their innovation processes based on real-time learning. Thus, hackathons function not as isolated interventions, but as iterative innovation learning systems—where the accumulation of outputs and outcomes leads to the intentional redesign of inputs, driving ever more effective innovation cycles and organizational evolution.

6. Conclusions

6.1 Theoretical Contribution

This study advances the theoretical understanding of hackathons by positioning them not merely as isolated creative events, but as structured, iterative mechanisms for building dynamic innovation capabilities. By integrating insights from innovation theory, organizational learning, and the resource-based view, the proposed conceptual framework illuminates the role of hackathon elements - inputs, execution, and post-event integration

- in fostering corporate innovation and strategic agility. It bridges a critical gap in literature by mapping hackathon design to strategic outcomes, thereby contributing a mid-range theory that links micro-level practices with macro-level competitive positioning.

6.2 Practical Implications

For practitioners, this research offers a blueprint for designing and managing hackathons as high-impact, repeatable innovation interventions. The framework identifies critical success factors such as team diversity, challenge framing, mentorship, and follow-up structures, providing actionable guidance on how to align hackathon practices with organizational strategy. By emphasizing post-hackathon development, the study also alerts managers to the risk of innovation theater and underscores the need for mechanisms that sustain project momentum, integrate ideas into R&D pipelines, and reinforce innovation culture.

6.3 Future Research Developments

While this study provides a robust conceptual model, further empirical validation is required across different organizational and industry contexts. Future research should explore longitudinal impacts of hackathons on organizational learning, employee behavior, and product innovation cycles. Quantitative studies could measure the effects of specific design variables (e.g., mentor density, jury structure) on innovative outcomes. Moreover, deeper investigation into equity, inclusion, and team dynamics within hackathons would enrich our understanding of how to design more inclusive and resilient innovative environments.

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Ethics Declaration

This study did not involve any experiments with human participants, animals, or sensitive personal data requiring ethical approval. Therefore, ethical clearance was not required. All secondary data and literature used in this paper were obtained from publicly accessible and properly cited sources.

AI Declaration

This paper involved the use of an AI language model (ChatGPT by OpenAI) to support language refinement and formatting clarity during manuscript preparation. The tool was used to improve the articulation of ideas originally developed by the authors. All AI-assisted texts were reviewed and edited to ensure academic integrity and accuracy. The authors bear full responsibility for the content, analysis, and conclusions presented in this manuscript.

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Towards Sustainable Value Creation: Students' Perspective of Team Learning

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Abstract: This paper studies student's perceptions to team learning and team entrepreneurship (TLE) study path that has been employed to offer students a possibility to learn as team entrepreneurs in a Finnish Higher Education Institute since 2010. The goal for the study was to explore what kind of experiences current and alumni students have about the TLE study path, and how they value their experiences. The study is part of a larger study started in 2024. Data for the paper is qualitative and consists of three different datasets, one questionnaire for current students (n=24), and another questionnaire for alumni (n=9). In addition, 17 theme-based interviews were done among the TLE alumni, total number of informants is 50. Grounded theory method including open, axial, and selective coding phases guided the data analysis. The results show that the TLE alumni value both meta-learning such as teamworking and dialogue skills and developing their content skills like understanding of how digital marketing tools are used in real customer projects. As a valuable topic discussed by the TLE alumni, was persistence to try and try again, and not to give up, to develop one's abilities to learn. The regards the alumni wanted to send to current TLE students as well as organizing staff of the study paths was to foster to coach the ability to learn and adapt for students. In these current unpredictable times developing one's resilience was expressed as crucial. It was also suggested that the coaching process should include some mandatory elements such a book everyone should study or tools everyone should learn to guarantee a more common knowledgebase for the team.

Keywords: Team Learning and Team Entrepreneurship Study Path (TLE), Labtic, Team Learning, Grounded Theory, Qualitative Research, Perceived Value

1. Introduction

In Finland, economic bottom shed has been continued for over fifteen years. There are several external factors affecting the situation, for example the recent Covid-19 and energy crisis. Despite these external factors affecting globally, there are always also internal factors either fostering or inhibiting the economy. Even though the public sector can offer proper circumstances to growth, sustainable growth can only be achieved when markets are working well, and existing companies are willing to grow or individuals with new businesses ideas are ready to act. This will require reasonable taxation (see Murto et al. 2025 more) but also changing individuals' mindset concerning entrepreneurship. One way to make an impact on the latter is entrepreneurship education (EE).

Finnish Ministry of Education and Culture (Ministry of Education and Culture, 2017) has set objectives for the EE. They are to increase positive attitude towards entrepreneurship, strengthen entrepreneurial actions, develop knowledge and skills of entrepreneurship, recognize one's own skills related to entrepreneurship, increase readiness for entrepreneurship, and create new entrepreneurship. The EE research lists three different approaches to how to employ the EE. They are learning about, learning for, and learning through entrepreneurship (Gibb 2005; Lackeus, 2015). These approaches require different pedagogics and in higher education the suggested focus for the EE has been suggested to put on learning through entrepreneurship in a proper learning environment.

At LAB University of Applied Sciences (LAB UAS), the learning environment for offering students who will focus on studying marketing, a possibility to learn as entrepreneurs is called Team learning and team entrepreneurship path, a TLE. The TLE includes also its first spinout implementation, a Labtic study path.

2. The TLE and the Labtic in a Nutshell

The TLE study path was established in 2010 at Saimaa University of Applied Sciences, (since 2020 LAB UAS), so it has already been running for over fifteen years. TLE offers those students who will focus their studies on marketing the possibility to establish a cooperative type of company with their peers and run its operations for two and half years as a team entrepreneur. They acquire customers, make projects for them, and send invoices for their work as the normal company does. The studies consist of customer projects, studying theory by reading books and valid online materials, having tryouts twice a week to share knowledge, reflect on learning

experiences, and to ideate new project possibilities. Every now and then, the team will execute an innovation assignment, where a customer offers a demanding challenge, and the team will solve it in 12 or 24 hours.

For each team, the LAB UAS appoints a team coach, who will facilitate the students with their professional development and their team building efforts. A team coach helps the students to define their learning goals and develop a plan for how to achieve them. A definition for the coaching was adapted from Myles Downey and it was: "Coaching is the art of facilitating the performance, learning and development of another." (Downey, 2003, p. 21). An essential learning method at the TLE is dialogue (see Isaacs, 1999 for more). Every student will become familiar with principles of dialogue and at the beginning of the coaching process the team coach will actively facilitate this. Development from a working group to a potential team also includes a lot of well-studied topics that have been utilized in development of the TLE study path. These include group dynamics (Levi, 2007), team performance (Katzenbach & Smith, 2001), and typical dysfunctions of a team (Lencioni, 2012) to name a few (see Juvonen, 2014 for more). An overview of the TLE study path is presented in figure 1.

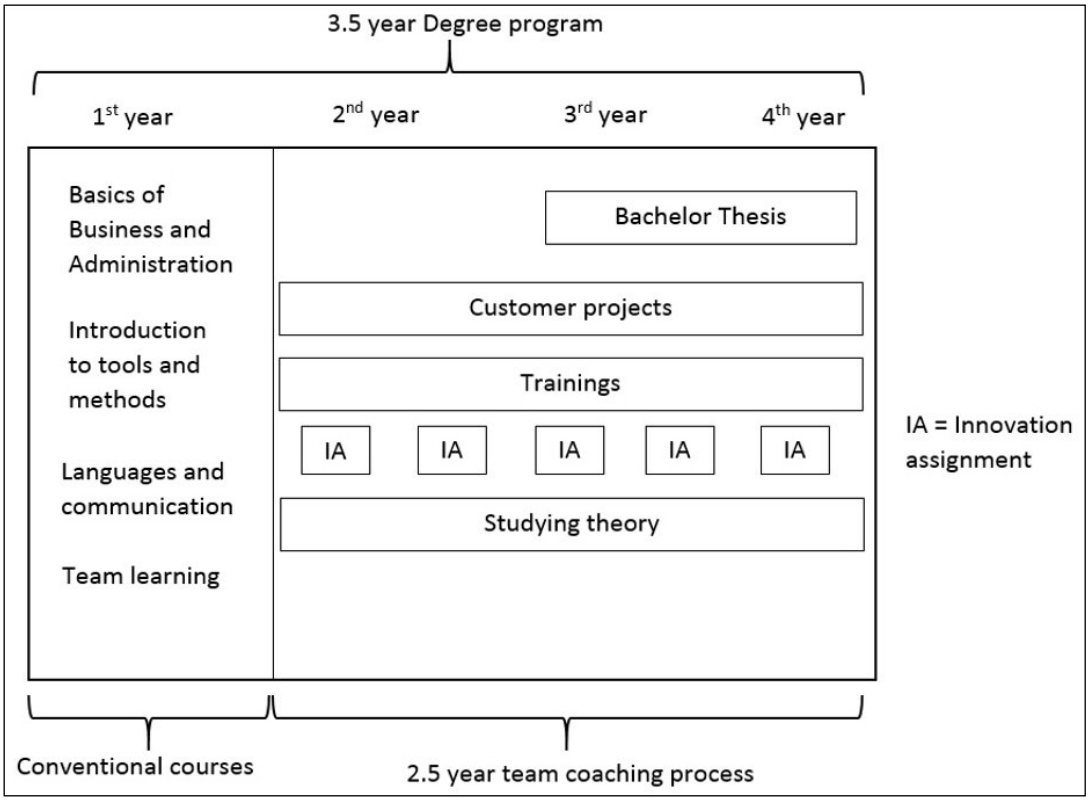


Figure 1: An overview of the TLE study path (Juvonen & Kurvinen, 2018).

Since 2022, a Labtic study path has also been employed. The Labtic focuses on digital marketing skills, and it also utilizes team learning methods in its coaching process. The Labtic students also carry out customer projects and tryouts, utilizing learning materials from versatile sources. The students will study from 6 – 12 months on the study path. The students are supported by a group of coaches and senior lecturers who cooperate and coordinate the studies on the study path.

3. Data Collection and Analysis

In 2024 a study of the TLE study path and its successors was made (Juvonen, 2024). Good practices and places of improvements were discovered, and future considerations related to pedagogical viewpoints and the study paths' ability to adapt to fast technological changes were discussed. Data for the previous study was collected by interviewing team coaches, lecturers and their superiors responsible for the study paths. The previous study did not include current and alumni students' viewpoint. This study will complement the ongoing study of the TLE study path and its spinout Labtic. In this study, current TLE students, and TLE and Labtic alumni were studied. Customers' voice and perceived value (Woodruff, 1997; Aulia et al. 2016) expressed by them was a topic of interest.

Data collection consisted of three different datasets including two surveys and a set of theme-based interviews. A total of 50 informants participated in this study as data sources. The data sets are presented in table 1.

Table 1: Description of the datasets.

Type of Dataset	n	Description
Survey #1, via Webropol	24	S101 – S124, open-ended questions for current students of the TLE study path.
Theme-based interviews, via Teams	17	I01 – I17, open ended questions for the TLE study path alumni. The interviews lasted from 45 to 75 minutes.
Survey #2, via Webropol	9	S201 – S209, open-ended questions for Labtic alumni.

A research question for the study was: "*How TLE study path is valued among current and alumni students?*". Both the surveys included open-ended questions where respondents were asked about their positive and negative experiences and what they felt was valuable in their studies. They were also asked to send regards both to current students as well as team coaches and other personnel organizing the TLE and / or Labtic study paths.

The data analysis followed the principles of grounded theory method (Strauss & Corbin, 1997; Corbin & Strauss, 2008; Flick, 2009). The analysis included open, axial, and selective coding phases. During the open coding phase, the data was freely explored, and notes of interesting and repeating phenomena were gathered. The axial coding phase was done in parallel with the open coding and it included grouping and re-organizing of the pre-existing and emerging categories and observing how they related to each other. In the selective coding phase, the results of the study were written.

At the beginning of the analysis, the seed categories for the analysis emerged naturally from the survey questions and the themes discussed in the interviews. In the beginning of the analysis, the seed categories were positive and negative experiences of studies, perceived value of studies, and feedback to current students and personnel. During the open-coding phase, the positive experiences and perceived value categories started to merge. In the axial coding phase, it was also noticed that when interviewees discussed their negative experiences, many of them at the same time reflected on what they had learned about them, and how those experiences had offered them possibilities to personal growth. By reflecting on negative experiences many interviewees recognized what they had learned and reframed the experience as a source of value. Sustainable value perceived and reflected by the informants formed the core of the data.

4. Results of the Study

The results of the study including positive and negative experiences that current and alumni students had, and what they perceived as valuable in their studies are shortly presented here. The regards the interviewees wanted to send to current students and the organizers of the study paths are also shown. A set of quotations from the three datasets will also be presented and some observations on differences of perceived value between the data sets are being summarized.

4.1 Positive Experiences of Studies

In all three datasets the most common positive experience expressed by the interviewees was learning practical marketing skills in customer projects. Practicing the skills in customer projects and seeing the results, especially satisfied customers after projects, was a strong positive experience for several informants. Some alumni also highlighted the importance of reading professional literature and expressed that they are still doing it. Here an example of how it was expressed by the interviewees:

> *"The best part was customer projects where I learned both communication and marketing skills. Working with highly motivated people increased also my own motivation."* – S204 –

Another set of expressions related to freedom to explore and experiment to find what might interest and to what one could focus on her studies, were also widely raised by the informants. The TLE alumni also discussed how their self-assurance developed in the process of taking responsibility for making decisions about their learning objectives. One example of this is as follows:

"I was able to affect what to study if it related to marketing. It helped me to concentrate on the topics I was interested in. In life you must learn to be proactive and make initiatives. I learned more of these skills during studies." – I04 –

4.2 Negative Experiences of Studies

Freedom to explore and experiment to find focus and set individual learning examples was also expressed from a negative viewpoint. Some interviewees told that this, "getting too much responsibility too early", might have been a challenge for someone. At the same time these informants felt that they personally were ready and eager to take responsibility, and the amount of responsibility was not an issue for them.

The freedom and responsibility to advance in studies also raised several comments of "free riders", meaning students who were not so active in teamwork. Several current and alumni TLE students expressed their worry about team members who had not shown commitment to act as the study path anticipated. It was also suggested that there should be an interview or some other way to select motivated students for the study path. In addition, it was suggested that students should be informed as well as possible before entering the study path because it requires intrinsic motivation to learn. Those who search for easy and quick way to get a diploma, should choose another study path for themselves. Here are two quotations from the interview data:

"Nothing negative. Someone had chosen a wrong study path for herself, but they left to study with another study path." – I09 –

"Some individuals had very strong opinions and they did not welcome other opinions that were not in line with their own opinions. They seemed to want to emphasize themselves individually instead of team. Luckily there were only few of them and these decided to leave the TLE study path quite soon." – I02 –

4.3 Regards for the Current Students and the Organizing Staff

Regards from current students and alumni are very valuable to organizing staff of the study paths. Learning to learn, including courage to explore different topics and focus when something interesting is found, teamworking and dialogue skills including ability to give and get feedback, and reflect one's own actions based on the feedback, were all among the regards to the current TLE and Lactic students. The alumni also recommended current students to take benefit or their study path to experiment and search what might interest them. It was also expressed by several interviewees that things change so rapidly that it is wise to learn principles or ideas of certain topics because the details and tools in operative change soon anyway. Here is two examples from the interviews:

"Your attitude will make a difference. Consider what you promise and when you make a promise, deliver what you have promised. It will positively separate you from many others." – I02 –

"Put effort to your learning. Admit that you will not get any results without working for them. When you learn to be hardworking and persistent, it will a longer run lead to success. And if in some cases it does not, you have at least given you best." – I09 –

When asking feedback from the alumni for the team coaches and other personnel, the theme of adding some jointly decided mandatory elements to the study program and team coaching process was expressed in several ways. It was seen as valuable to include the most essential books and tools as a mandatory part of the different phases of the learning process. Many interviewees felt that this would help team learning by offering students a common knowledge base to build on. When there is a lot of freedom in choosing what books to read, some students may end up not choosing the most relevant literature to study. Another topic of several feedback was related to rethinking how to offer flexibility to studies. Several interviewees expressed that team learning requires face-to-face tryouts and doing projects together with other students. However, it was also expressed that today, many students are forced to work in parallel with their studies, and without proper flexibility available in the study path they are not able to proceed with their studies. Here is one example of the feedback:

"*The combination of customer project, tryouts, reading books, and innovation assignments was good. I would add some supervising elements such as mandatory books and marketing tools to the study program. It does not have to be the same tool for everyone but rather some choices instead. This would help to diminish freeriding and help to build common knowledgebase within the teams.*" – I16 –

4.4 Perceived Value

It is notable that all the TLE alumni students (n=17) were eager to evaluate their experiences of value in several ways during the interview. First, when they were asked to recall positive and negative experiences from their time as a student at the TLE study path. Secondly, they were directly asked what they felt offered value to them and whether their experience of the gained value had changed after their graduation. Third time perceived value was discussed again when the alumni were asked to give feedback to current TLE students. At this time, they reflected on what they had got, and some did also reflect on what they would do otherwise if there were students again. After these considerations they moved to discuss their regards to the current students at the TLE study path. Several interviewees hoped that current TLE students would "take care of the community" that had offered the alumni so much. Here are some examples of different ways how this was expressed:

> "*Learning via real customer projects with companies should be increased in every study path, not only in the TLE.*" – I04 –
>
> "*Find out what interests you and then focus into it! Do not be afraid to make choices and concentrate on learning topics that you feel are hard or challenging for you. By repeating something you are not familiar with it, it will make you familiar with it. Be ready to put effort on your learning!*" – I07 –
>
> "*You may and you must be demanding*." – I08 –
>
> "*I would not change anything. This study path had a significant impact on me and what I have professionally become."* – I12 –

4.5 Summary of the Results

A total of 50 respondents in three different data sets offered rich data for the analysis. An example set of quotations from the three dataset is presented in table 2.

Table 2: Exhibition of quotations from three data sets.

	Current TLE Students	TLE Alumni	Labtic Alumni
Positive experiences	"We have actively searched for good projects and have also found them." – S101 – "I am on time with tryouts and reading books. This is something that I can take care of myself." – S113 – "We have a good atmosphere within the team. It motivates me." – S102, S108, S119, S120, S121	"I learned to read professional literature and learn via that. I still read books." – I11 – "I learned how to work in a group and have conversations, organize and lead own actions and work overall. This is something that is still useful in working life and it seems that many employees miss these skills." – I02 – "Marketing skills increased a lot. We really took marketing actions, experimented and tested what made impact, instead of studying them in theory." – I07 –	"I liked the combination of learning theory then and practicing it in customer projects after that." - S202 – "I liked the combination of theory and applying it into customer projects. I felt that learning happened almost by itself. I noticed that teachers wanted to help students to learn, and this affected to me a lot." – S03 –
Negative experiences	"Reading books is too demanding." – S105, S109, S122 – "There are too many books to be read." – S111, S116, S120, S121 -	"I think the TLE study path may have required too much responsibility too soon from someone. For me it was not a challenge, but it might have been a challenge for someone." - I01, I17 – "Some students tried to bend the rules my reading not so relevant books while others did not. This caused some disagreements during the studies. I may have been one of those who tried to find an easy way to advance." – I06 –	"We had some challenges in the beginning of the teamwork. I felt that this was normal and appears everywhere also in working life." – S205, S207, S208 – "Sometimes it was a bit challenging to learn to use digital marketing tools." – S201 –

	Current TLE Students	TLE Alumni	Labtic Alumni
Topics that were expressed as most valuable	"Customer projects are the most important way for me to learn." – S117 – "Customer projects are important" – S101 – S0124 (all informants) –	"Community and teamwork. We had a team where we, in a positive sense, pushed each other to be better. " – I16 – "I think that in parallel with marketing I learned good practical project management skills. I experienced how many different things you must take care of if you want to succeed in project." – I05 – "There were lot of practical good for me. I got encouraged, I learned to speak up, I learned teamwork." – I17 –	"The best part was customer projects where I learned both communication and marketing skills. Working with highly motivated people increased also my own motivation." – S204 – "I was able to concentrate into those topics of marketing I was most interested." – S209 –
Feedback to current students	"This demands lot of commitment and will. You cannot be partly involved. Every student should notice this." – I120 – "This study path is excellent for those students who can commit and be self-imposed." – S111 –	"You will learn crucial working life skills that you will need also later during your career. In example social skills are not something that everyone has in working life but as a team entrepreneur alumnus I am good in them. These skills form a basis for other things." – I02 – "It can be challenging to change your surroundings, but you can always change yourself and your attitude." – I10 –	"Teamworking skills and balance of how work is divided within team is a challenge also in working life. Put effort to learn teamwork." – S205 – "Teamworking and customer projects will develop your self-assurance. Take benefit from that." – S207 –
Regards to the team coaches and other personnel	"Thank you for your support. You all are competent and committed to help us to learn." – S110, S111, S121 – "Evaluation criteria must be exactly similar between team coaches. I see here a place for development." – S102, S110, S118 –	"Everyone should make oneself familiar with commonly used marketing tools at the beginning of their studies. This could be supported with relevant books, and book dialogue bases on the books." – I15 – "Overall, the package was good, different elements: customer projects, tryouts, reading books, and innovation assignments were balanced. In some cases, a lot of freedom may have been a challenge for someone, and it may have led to underperformance." – I01, I09 –	"Labtic was awesome. Less slides and more learning by doing!" – S201 – "I feel privileged to for having a possibility to study at Labtic. I was able to learn skills that most students will get only when they go to working life." - S204 –

The results show that there were some clear differences between current and alumni students in how they evaluated their study path. The current TLE students emphasized customer projects and practical skills they develop in them in a positive sense. Some interviewees also discussed team spirit and how it positively affected their personal motivation. Many of the interviewees seemed to be in the process of deciding whether to commit or not to study how the TLE study path requires. Objectives to study theory in parallel with doing customer projects were shown to be too demanding by many.

The Labtic alumni emphasized the combination of customer projects and studying theory in their expressions. They valued practical skills and recognized the importance of the team working skills. Many interviewees expressed the difference between their earlier experiences in their studies when participating in courses compared to the experience at the Labtic study path. Having the possibility to do practical projects for customers with suitable digital marketing tools was valued a lot.

The TLE alumni felt that working life skills such as teamwork, dialogue, and self-leadership skills represented the most important set of skills of their studies. They also valued the possibility to experiment and explore different content-specific topics of marketing to find their personal interests. After finding personal interests, it was also seen valuable to be able to focus one's studies on them. Many TLE alumni expressed that after finding their own interest it helped to acquire suitable projects and literature to support one's learning. Some interviewees also reflected on how they have afterwards realized that they hesitated too long to choose their focus.

5. Summary and Discussion

The motivation for this study was to get an understanding of those viewpoints and be able to build a coherent general view of how these study paths currently operate and whether there might be need for adjustments. The previous study (Juvonen, 2024), the viewpoint of current and alumni students was missing and this study gathered it.

The interviewees from the TLE alumni dataset highlighted the meta-learning skills above the content-related skills. Many of them felt that learning how to learn, self-leadership and team learning skills were the most valuable assets bringing sustainable value to their career. They expressed that content-specific knowledge becomes irrelevant quickly, but these skills sustain. They are also part of practical resilience, as one of the interviewees put it. The same set of skills were again emphasized when the alumni were asked to give advice or feedback to the current TLE students.

It was remarkable that none of the alumni students either answered the questionnaire or interviewed (n=26) was afterwards sad about the high demands of the study path. On the contrary, several alumni students highlighted the importance of taking actions to go to discomfort zone, repetition of doing it and reflection of one's actions personally and within the team, to professionally develop. When asked what regards the interviewee would like to send to current students at the TLE study paths, courage to experiment new was emphasized by several interviewees. Several interviewees also expressed how they had and still benefit from these skills themselves in their work.

A question of where to focus on these unpredictable times is one's personal growth, and ability to adapt to changes which can also be referred to as resilience. It includes both developing learning to learn skills and exploring different content topics to find what might be worth focusing on. New information will be available rapidly, and therefore an ability to unlearn things that have become irrelevant to being able to learn something has also become crucial.

Both the organizers, team coaches and other personnel, and the customers, current and alumni students saw the TLE as a solution to offer sustainable value to students in these times of uncertainty. With minor updates such as adding some mandatory elements to the coaching process and offering more flexibility for the students, the TLE and the Labtic study paths offer a solid learning environment to equip its students to current, rapidly changing working life. It offers the students a set of important skills for their career and fulfills the objectives set for the Finnish higher education institutes for the EE.

Ethics Declaration

This research did not require ethical approval. All participants gave informed consent prior to participation in interviews.

AI Declaration

This paper of fully created by the author. No AI tools were used during the data collection, data analysis, or writing process of the paper.

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Effects of Regulatory Quality and Political Stability on Sustainable Competitiveness in the EU: The Mediating Role of Environmental Innovations

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Abstract: With rising environmental challenges, the role of policymakers in promoting eco-innovation has become increasingly critical. This study examines how political stability and regulatory quality influence environmental innovation and sustainable competitiveness in the European Union. Using Partial Least Squares Structural Equation Modeling (PLS-SEM) on panel data from 27 EU countries (2017–2022), the study investigates both direct and indirect effects of governance quality. The findings indicate that political stability and regulatory quality significantly enhance eco-innovation, which mediates their impact on sustainable competitiveness. A stable and predictable regulatory environment reduces uncertainty, supports investment in green technologies, and fosters private sector engagement in sustainability initiatives. These results highlight the strategic role of governance in enabling eco-innovation and advancing sustainable economic growth. The study offers practical insights for policymakers seeking to strengthen governance mechanisms—such as regulatory predictability and mission-oriented innovation policies—to create favorable conditions for eco-innovation and long-term competitiveness.

Keywords: Sustainability, Eco-Innovation, Sustainable Competitiveness, Policy Measures, Regulatory Mechanisms

1. Introduction

The increasing urgency of environmental challenges has prompted the European Union (EU) to emphasize the integration of long-term economic competitiveness with environmental sustainability. Frameworks such as the European Green Deal, the Industrial Strategy, and the Fit for 55 packages identify eco-innovation as a key driver of this transition. However, despite rising investments in green technologies, significant differences persist among member states in the implementation and diffusion of sustainable innovation.

A major explanatory factor for this divergence lies in governance quality, particularly political stability and regulatory effectiveness. Stable and predictable governance systems are widely seen as essential for reducing uncertainty, encouraging investment, and creating the conditions necessary for eco-innovation and competitiveness. Yet many existing studies consider governance, innovation, and competitiveness in isolation, which limits the understanding of their systemic interactions.

This study is motivated by the need to better understand how governance quality affects sustainable competitiveness in the EU, especially through its impact on eco-innovation. While prior research has highlighted the individual importance of governance and innovation for economic and environmental outcomes, comprehensive empirical analyses that integrate these relationships remain limited. Addressing this gap is critical for identifying how institutional settings can support the green transition and strengthen national competitiveness.

This paper therefore examines the relationship between governance quality, eco-innovation, and sustainable competitiveness in EU countries, considering both direct and indirect pathways. Governance quality is operationalized through indicators of political stability and regulatory quality, while eco-innovation is treated as a mediating factor that translates institutional conditions into economic and environmental performance. The analysis employs Partial Least Squares Structural Equation Modeling (PLS-SEM) on panel data from 27 EU countries over the period 2017–2022.

By exploring both the direct and indirect effects, this study provides new insights into the institutional factors shaping the green transition in the EU. The findings aim to inform policymakers and practitioners seeking to design governance frameworks that are aligned with sustainability objectives under conditions of regulatory and technological uncertainty.

RQ: *How does governance quality influence sustainable competitiveness in EU countries, and to what extent is this relationship mediated by eco-innovation?*

The remainder of this paper is structured as follows: Section 2 reviews relevant literature; Section 3 describes the data and methods; Section 4 presents the empirical results; Section 5 discusses the findings; and Section 6 concludes with implications and suggestions for future research.

2. Literature Review

The relationship between governance quality, eco-innovation, and sustainable competitiveness is grounded in well-established institutional and innovation theories. According to North (1990), institutions — including formal rules, regulations, and informal norms — shape the incentives and constraints faced by economic actors, thereby influencing investment decisions and innovation dynamics. A stable and predictable institutional environment reduces uncertainty and fosters long-term commitments to technological change (Acemoglu et al., 2005; Kaufmann et al., 2009).

In the context of environmental and sustainability transitions, eco-innovation systems underscore the critical role of governance structures in shaping innovation outcomes. Eco-innovation is often driven by a combination of regulatory push and market pull mechanisms, which together create favorable conditions for firms and industries to develop and adopt environmentally beneficial innovations (Rennings, 2000; Borghesi et al., 2015). Hojnik et al. (2022) and Zhao et al. (2022) emphasize that governance quality, through the design and implementation of coherent policies, directly supports the diffusion of eco-innovations.

This perspective aligns with the Porter hypothesis, which argues that well-designed environmental regulations can stimulate innovation that partially or fully offsets compliance costs, ultimately enhancing competitiveness (Porter & van der Linde, 1995). More recent contributions by Blind (2016) and Ghisetti & Quatraro (2017) extend this logic by demonstrating that regulatory quality, flexibility, and predictability are essential for transforming compliance obligations into drivers of technological advancement.

The linkage between eco-innovation and sustainable competitiveness is also highlighted by studies focusing on resource efficiency, green value creation, and the broader impacts of environmental innovation on national and firm-level performance. Cainelli et al. (2015) and Filippetti & Archibugi (2011) show that eco-innovation not only contributes to environmental goals but also enhances productivity and long-term competitiveness. Mazzucato (2018) further underscores the importance of mission-oriented policies that align public investments and regulatory frameworks with sustainability objectives, fostering innovation ecosystems capable of addressing systemic challenges.

Taken together, these theoretical insights provide a solid foundation for investigating how governance quality influences sustainable competitiveness, particularly through its effects on eco-innovation. By integrating these streams of literature, this study seeks to fill an important empirical gap and offer a nuanced understanding of the institutional mechanisms underpinning the green transition in the EU.

3. Data and Method

The empirical investigation is based on a panel dataset covering all 27 EU member states over the period 2017–2022. This timeframe captures both the lead-up to and early phases of policy implementation associated with the European Green Deal and related sustainability initiatives.

Data were drawn from internationally recognized and methodologically harmonized sources, including Eurostat, the World Bank's Worldwide Governance Indicators (WGI), the OECD Statistics Database, and the V-Dem Institute. These sources are widely used in comparative research and ensure high levels of consistency, transparency, and comparability across countries and over time (Prokop & Hájek, 2023; Giglio et al., 2023).

The conceptual model includes three latent constructs—Governance Quality, Eco-Innovation, and Sustainable Competitiveness—which are operationalized using composite indicators derived from established theoretical and empirical literature, particularly institutional theory, eco-innovation system frameworks, and sustainability performance metrics. To improve explanatory validity and account for country-level heterogeneity, we also include control variables reflecting national economic capacity and R&D intensity. Table 1 provides a full overview of all constructs, indicators, units of measurement, and data sources.

Table 1: Description of variables

Latent Variable	Indicator	Description	Unit of measurement	References
Government (GOV)	PSB	Political stability	range from (-2.5;2.5)	World Bank
	RGQ	Regulatory quality		
Eco-innovation (ECO)	ECA	Eco-innovation related academic publications	score	OECD Statistics, Eurostat
	ECP	Eco-innovation related patent	score	OECD Statistics,Eurostat
	VAE	Gross value added in environmental goods and services sector	% of GDP	Eurostat
Sustainable Competitiveness (SC)	REI	Resource Intensity	score (0-100)	OECDStatistics, Eurostat
	SUC	Sustainable competitiveness	score (0-100)	Eurostat
Control variables (CV)	GNI	Gross National Income	US dollar per capita, PPP	World Bank
	R&D	R&D expenditure	Euro per Inhabitant	Eurostat

The analytical strategy employs Partial Least Squares Structural Equation Modeling (PLS-SEM), estimated in SmartPLS 4. This method is particularly appropriate for models with complex causal relationships, latent variables, and mediating effects, as well as for datasets that may not meet multivariate normality assumptions (Hair et al., 2019; Henseler et al., 2015; Hojnik et al., 2022). Moreover, PLS-SEM enables the estimation of both formative and reflective constructs and is well suited for theory development and explanatory research.

Following recommended best practices (Hair et al., 2019; Sarstedt et al., 2020), the estimation proceeded in two main stages. First, the measurement model was evaluated to ensure the reliability and validity of all latent constructs. This included assessments of indicator loadings, internal consistency (Cronbach's alpha and composite reliability), convergent validity (Average Variance Extracted, AVE), and discriminant validity using the Fornell–Larcker criterion and the Heterotrait–Monotrait ratio (HTMT). All constructs met or closely approximated the standard thresholds, confirming the robustness of the measurement model.

Second, the structural model was assessed to examine the directional relationships among latent constructs as specified in the conceptual model. Path coefficients and their statistical significance were estimated using a bootstrapping procedure with 5,000 resamples. In addition, the model's coefficient of determination (R^2) and predictive relevance (Q^2) were calculated to assess the explanatory power and predictive accuracy of the endogenous constructs. These diagnostics provide a comprehensive understanding of how governance and innovation-related factors interact to shape sustainable competitiveness across EU countries.

The methodological framework applied in this study reflects recent advances in sustainability research and aligns with similar studies using SEM-based approaches in institutional and innovation contexts (e.g. Hojnik et al., 2022). By combining established theoretical frameworks with a structural equation modeling approach and a panel dataset covering EU countries, the study provides an empirical basis for examining governance-driven innovation dynamics.

4. Results

The analysis commenced with an assessment of the measurement model, emphasizing factor loadings, composite reliability, and average variance extracted (AVE). To establish the model's reliability and convergent validity, factor loadings were required to exceed 0.70, composite reliability to be above 0.70, and AVE to surpass the threshold of 0.50 (Richter & Tudoran, 2024). Satisfying these criteria is essential for confirming the adequacy of the measurement model prior to proceeding with the evaluation of the structural model (see Table 2). All

constructs exceeded the recommended thresholds for factor loadings (>0.70), composite reliability (>0.70), and average variance extracted (>0.50), confirming the reliability and convergent validity of the measurement model. Although the HTMT ratio between eco-innovation and sustainable competitiveness slightly exceeded the commonly cited threshold of 0.90 (HTMT = 0.903), this deviation was minimal and did not compromise the overall discriminant validity.

Table 2: Factor Loadings, Composite Reliability, AVE.

Construct	Indicators	Factors Loading	Composite Reliability	AVE
Government (GOV)	PSB	0.822	0.867	0.767
	RGQ	0.926		
Eco-Innovation (ECO)	ECP	0.820	0.834	0.626
	ECA	0.779		
	VAE	0.774		
Sustainable Competitiveness (SC)	REI	0.849	0.875	0.779
	SUC	0.915		
Control variables (VC)	GNI	0.941	0.948	0.901
	RD	0.958		

Source: Author's calculation based on SmartPLS 4 outputs

Once factor loadings, composite reliability, and AVE have been verified, the next phase in evaluating the measurement model involves confirming discriminant validity, which ensures that the constructs are empirically distinguishable. This can be assessed using the Fornell-Larcker criterion, which states that the square root of each construct's AVE should be greater than its correlations with any other construct (Hamid et al., 2017). In addition, the Heterotrait-Monotrait Ratio (HTMT) provides a more stringent test by examining inter-construct correlations, with a commonly accepted threshold of 0.85 (Dirgiatmo, 2023). Nonetheless, some researchers suggest a more lenient cutoff of 0.90 (Hamid et al., 2017). Satisfying these conditions indicates that each construct reflects a distinct concept, thereby supporting the measurement model's validity prior to structural model evaluation.

Table 3: Heterotrait-Monotrait Ratio of Correlations

	CV	ECO	GOV	SC
CV				
ECO	0.890			
GOV	0.836	0.850		
SC	0.776	0.903	0.758	

Source: Author's calculation based on SmartPLS 4 outputs

Based on the results of the discriminant validity analysis, each construct demonstrates the highest loading on its own indicators, which is an expected and desirable outcome. However, a minor issue emerges in the HTMT values, as shown in Table 3—specifically between Sustainable Competitiveness and Eco-Innovation, where the value slightly exceeds the recommended threshold of 0.90. Despite this modest deviation, the constructs can still be regarded as sufficiently distinct, as the exceedance is minimal and does not significantly compromise the overall validity of the measurement model.

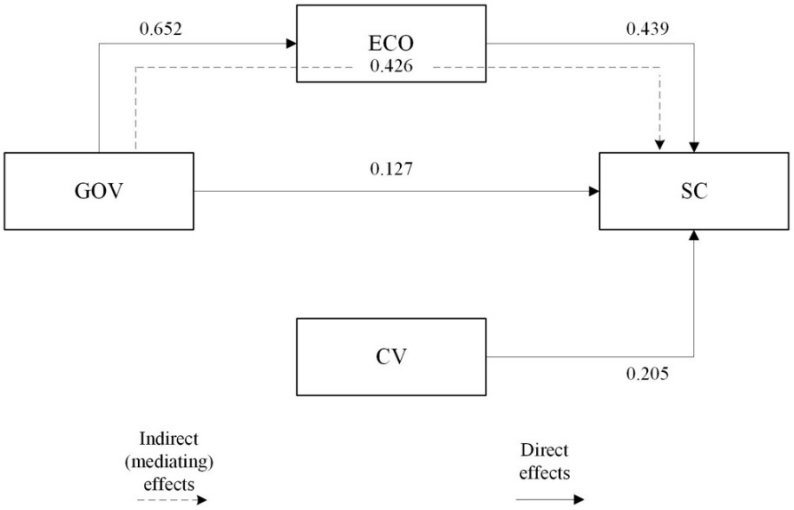


Figure 1: Research model

These findings empirically address the research question by demonstrating that governance quality, operationalized as political stability and regulatory quality, significantly impacts sustainable competitiveness both directly and through the mediating effect of eco-innovation.

The structural model results clearly address the RQ. Governance quality significantly increases eco-innovation, which in turn boosts sustainable competitiveness. The direct effect of governance on competitiveness is not significant, indicating a full mediation through eco-innovation.

5. Discussion

This study was motivated by the question of how governance quality influences sustainable competitiveness and whether eco-innovation mediates this relationship. The empirical results confirm the hypothesized direct and indirect effects, supporting the proposed conceptual framework and answering the research question. The empirical findings of this study provide preliminary findings that governance quality—captured through political stability and regulatory quality—plays a significant enabling role in fostering eco-innovation, which in turn enhances sustainable competitiveness in the European Union.

5.1 Theoretical Implications

The results suggest a full mediation effect, were governance quality influences sustainable competitiveness only indirectly through eco-innovation. This finding extends prior research by indicating that institutional quality does not directly impact economic outcomes but operates primarily through its effect on innovation dynamics. This is consistent with theoretical frameworks emphasizing the role of innovation as an intermediary channel linking governance structures to performance outcomes (Ghisetti et al., 2017). These findings are consistent with the eco-innovation system perspective, which posits that innovation outcomes, particularly in addressing environmental challenges, are strongly influenced by the institutional and policy environment. The full mediation effect observed in this study supports the view that governance structures impact sustainable competitiveness primarily by enabling eco-innovation processes (Zhao et al., 2022; Hojnik et al., 2022).

In particular, the results suggest that stable, predictable, and competent governance structures reduce uncertainty, support long-term planning, and foster commitment to environmental goals—conditions that are necessary for green innovation to flourish. This study also aligns with recent literature highlighting eco-innovation as a key mechanism through which institutional quality can affect economic and environmental performance (Giglio et al., 2021; Zhao et al., 2022; Prokop & Stejskal, 2021). By empirically examining this mediating role, our analysis complements earlier findings and offers macro-level insights into the governance–innovation–competitiveness nexus in the EU context. While prior studies have established bivariate relationships between governance and innovation (Borghesi et al., 2015), or between eco-innovation and firm-level competitiveness (Cainelli et al., 2015), few have integrated these constructs into a single empirical model. The results provide indicative support for the view that the impact of governance quality on sustainable competitiveness may be conditional on the presence of effective innovation mechanisms. In this context, eco-

innovation appears to serve as a key pathway through which institutional quality contributes to broader economic and environmental outcomes.

5.2 Managerial Implications

The results also carry important regional implications.

While the structural model was estimated on the full EU sample, regional disparities in governance quality and innovation capacity remain important considerations. The literature suggests that Eastern and Southern European countries often lag behind in both dimensions (Costantini et al., 2017). These findings underscore the need for differentiated policy approaches. In countries with weaker institutional environments, reforms aimed at improving regulatory predictability and administrative capacity may provide a critical foundation for the emergence of eco-innovation systems. This is particularly relevant in Eastern and Southern European countries, where innovation capabilities and governance effectiveness remain below the EU average (Costantini et al., 2021; D'Este et al., 2017). Conversely, in countries with more mature governance systems, policy should increasingly focus on scaling mission-oriented innovation, strengthening cross-sectoral coordination, and reducing administrative barriers—elements shown to accelerate green technology deployment (Mazzucato, 2018; Kivimaa & Kern, 2016). Another relevant dimension concerns regulatory design. It is not merely the presence of environmental regulation that matters, but also its quality, credibility, and alignment with innovation incentives. Recent studies support the view that well-designed regulation—when predictable, flexible, and innovation-friendly—can act as a stimulus rather than a constraint (Ghisetti & Quatraro, 2017). The positive association between eco-innovation and sustainable competitiveness observed in this study aligns with these findings and extends the Porter hypothesis to a macro-level, cross-country context (Blind, 2016).

In addition, the results highlight the value of academic and technological knowledge production—as measured by eco-innovation-related publications and patents—as important components of national competitiveness (Bruns et al., 2020). This observation is consistent with previous research emphasizing that innovation outcomes depend not only on input factors (such as R&D spending), but also on the effective diffusion and commercialization of scientific knowledge (Filippetti & Archibugi, 2011).

These findings support ongoing calls to strengthen science–policy–industry linkages, particularly in regions where the commercialization of public research remains limited. As shown by D'Este et al. (2017), the development of cooperative research networks, mission-driven partnerships, and international consortia—especially within frameworks like Horizon Europe—can help bridge the gap between institutional structures and innovation outcomes.

The model results indicate that institutional and innovation-related factors play a meaningful role in explaining variation in sustainable competitiveness across EU countries. This reinforces the view that governance quality plays a critical enabling role in shaping long-term sustainability outcomes. As countries around the world pursue green transitions, the capacity of governance systems to stimulate innovation may be a decisive factor in determining the success or failure of sustainability-oriented growth models. The insights provided here suggest that building institutional readiness for eco-innovation—through regulatory coherence, administrative capacity, and mission-oriented policy frameworks—is a necessary condition for achieving long-term competitive and environmental outcomes.

6. Conclusions and Implications

This study provides novel empirical evidence on the indirect mechanisms through which governance quality—captured through regulatory quality and political stability—enhances sustainable competitiveness in the European Union. By applying a PLS-SEM approach to panel data from 27 EU countries between 2017 and 2022, the analysis demonstrates that governance dimensions—specifically political stability and regulatory quality—do not exert a direct effect on competitiveness. Rather, their influence is channeled through eco-innovation, which emerges as a crucial mediating factor. The findings offer macro-level insights into the relationship between institutional quality, eco-innovation, and sustainable competitiveness in the EU context. These results empirically support the theoretical assumptions underlying the role of innovation systems in enabling eco-innovation and sustainable competitiveness (Horbach et al., 2012; Zhao et al., 2022).

The findings confirm that well-structured and predictable governance systems create an enabling environment for innovation aligned with environmental objectives. In particular, the mediating effect of eco-innovation—measured via patents, academic output, and gross value added in the environmental goods and services sector—

suggests that improvements in governance establish necessary institutional preconditions for innovation to flourish. This aligns with the conclusions of Prokop and Stejskal (2021), who emphasize the catalytic role of policy-induced innovation in converting governance capacities into economic performance outcomes. Based on these insights, the study formulates a set of actionable implications for two principal stakeholder groups: policymakers and firms.

From a policy perspective, five priority areas can be identified. First, ensuring long-term regulatory predictability is essential for reducing uncertainty and enhancing investor confidence in green technologies (Giglio et al., 2021; Borghesi et al., 2015). Second, public innovation funding should be strategically oriented toward mission-driven research that addresses systemic sustainability challenges, in line with recommendations by Mazzucato (2018). Third, green public procurement (GPP) should be employed as a strategic demand-side instrument to create lead markets for eco-innovations, particularly in sectors such as energy, construction, and transport (Edler & Georghiou, 2007). Fourth, institutional capacities for designing, monitoring, and implementing green regulations must be strengthened, especially in Eastern and Southern European regions where administrative constraints persist (Prokop et al., 2023; Costantini et al., 2017). Fifth, international collaboration through programs like Horizon Europe and alignment with the European Green Deal objectives are essential for scaling innovation and policy coherence across member states (Kivimaa & Kern, 2016).

At the firm level, several strategic responses are recommended. Companies should integrate environmental innovation into long-term planning and recognize environmental regulation as a potential source of competitive advantage rather than a constraint. Early adoption of green innovations often leads to first-mover benefits in emerging markets (Porter & van der Linde, 1995; Del Río et al., 2017). Firms are also encouraged to engage in cooperative R&D with universities and public research institutions, which can lower costs and improve access to advanced technologies (Cainelli et al., 2015; Horbach, 2008). Investing in long-term green technologies enhances not only compliance but also resilience, brand value, and adaptability (Costantini et al., 2017; Popp et al., 2020). Moreover, companies should develop robust internal systems for environmental reporting and governance, aligning with CSRD and ESG frameworks to meet growing expectations from investors and regulators (Sullivan & Gouldson, 2017). Lastly, proactive engagement in regulatory dialogues enables firms to anticipate compliance trends and contribute to shaping more effective and innovation-friendly policies (Johnstone et al., 2010).

7. Limitations and Future Research

While this study provides initial insights into the role of institutional quality in shaping sustainable competitiveness, several limitations should be acknowledged. First, the composite indicators used to measure eco-innovation—although widely adopted in cross-country analyses (Ghisetti & Quatraro, 2017)—may not fully capture qualitative attributes of innovation, such as their transformative capacity, environmental effectiveness, or technological novelty. Second, although the model includes relevant control variables and follows a theoretically informed structure, the possibility of reverse causality between governance quality and competitiveness cannot be fully ruled out, particularly in the absence of dynamic modeling (Hojnik et al., 2022).

Future research could benefit from the application of panel-based causal inference methods, such as system-GMM or difference-in-differences designs, to address endogeneity and better capture feedback dynamics over time (Bun & Kleibergen, 2021; Arkhangelsky & Imbens, 2023). Additionally, recent studies employing qualitative comparative analysis (QCA) have demonstrated its effectiveness in uncovering how various configurations of institutional, technological, and environmental factors influence green innovation outcomes across different national contexts (Liu H., 2025). Such approaches would enrich our understanding of institutional diversity and its implications for sustainability transitions.

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Ethics Declaration

This research did not involve human participants, personal data collection, or experiments requiring ethical approval. Therefore, ethical clearance was not required for the purposes of this study.

AI Declaration

AI tools were used solely for translation purposes. No AI tools were involved in the generation, analysis, or interpretation of the research content. The scientific content and conclusions remain the sole work of the author.

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Framing Inclusion in Entrepreneurial Ecosystems: A Systematic Literature Review and Research Agenda

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Abstract: The concept of inclusion is a timeless issue that is increasingly relevant for Entrepreneurial Ecosystems (EEs) and the European policy agenda in general. EEs are dynamic and highly complex structures which are shaped by external and internal forces, and a variety of stakeholders. They present the types of cultural, social, economic, and political resources that surround and support entrepreneurs. Even within the same EE, entrepreneurs with different social and economic profiles (e.g., female entrepreneurs, disabled persons, refugees, etc.) may encounter vastly different support services and opportunities. Many studies also highlight that most current ecosystem approaches do not pay enough attention to factors that structurally exclude and marginalize certain groups in entrepreneurship. Inclusion as a term refers to the process where secure citizens have the same opportunities to participate fully in economic, social and cultural life. Hence, it highlights having a certain standard of living and well-being, considered as normal in the society and context in which they live. Additionally, it encompasses equal access to the labor market, facilities, services, and resources. Applying this approach in the context of contemporary EEs is crucial to provide opportunities for every citizen and capitalize on the capabilities of a more diverse workforce. In this context, the U.N. has called for a review of ecosystems addressing the challenge of developing enterprises by the underserved. Consequently, the question arising is how current literature addresses inclusion in the context of EEs. This study aims to identify the contemporary academic understanding around inclusion in entrepreneurship, provide insights on the challenges for inclusion in EEs, and suggest actions that can enhance EEs in terms of inclusion. This work starts from gender inclusion and expands across the spectrum of excluded groups. To address this issue, a systematic literature review was carried out encompassing the research topic concerning the relationship between EEs and inclusion followed by an analysis of the main topic and issues identified. Using this approach, this work identifies gaps in the existing EE literature around the concept of inclusion while also providing a mapping of under-researched topics and highlighting under-represented groups and their current and potential connection to EEs.

Keywords: Entrepreneurial Ecosystems, Inclusion, Inclusive Entrepreneurship**,** Inclusivity

1. Introduction

The concept of inclusion has been at the forefront of the political, social, and academic landscape for several years and as such it has also increasingly infiltrated discussions within Entrepreneurial Ecosystems (EEs), highlighting the complexities and challenges that various stakeholders encounter in achieving genuine economic participation and representation. As EEs evolve to support a diverse array of entrepreneurial actors, it becomes crucial to explore how these ecosystems can be inclusive of marginalized and underrepresented groups (Hameed et al., 2023). The varying experiences of different groups—such as women, disabled individuals, immigrants, and refugees—within the same ecosystem illuminate significant disparities in access to resources and support, raising questions about the effectiveness of current inclusive policies (Aman et al., 2024; Motoyama et al., 2021).

Framing and defining inclusion play a vital role in understanding how entrepreneurs can fully engage in economic, social, and cultural life. The aspiration for inclusive participation extends to encompass the provision of equitable opportunities for all individuals, thereby promoting broader societal norms of well-being and economic stability (Bernstein et al., 2019; Cordier & Martin, 2022). Policies aimed at fostering inclusion are not only moral imperatives but also strategic approaches through which societies can leverage the diverse capabilities of their populations. The increasing emphasis on inclusion in the context of EEs connects to the larger framework of social equity, where disparities in entrepreneurial outcomes are scrutinized against the broader backdrop of cultural and socioeconomic conditions (Belitski et al., 2021).

Despite the significant attention given to EEs in academic literature, an important gap remains in understanding the intersectionality of inclusion within these systems. Academic investigations have thus far primarily steered towards high-growth entrepreneurship without adequately accounting for the experiences of marginalized demographics (Aman et al., 2024; David, 2025). A review of existing literature reveals various underexplored topics, indicating a need for comprehensive analyses focusing specifically on the inclusion of women and other marginalized groups (Kansheba & Wald, 2020; Malecki, 2018). Furthermore, existing studies frequently overlook

the systemic nature of the barriers that exacerbate exclusion, limiting their capacity to propose holistic solutions (Cantner et al., 2021).

This work aims to delve deeper into the contemporary understanding of inclusion within the sphere of entrepreneurship. Through a Systematic Literature Review (SLR), this research identifies gaps within the existing academic landscape and synthesizes insights on how to better facilitate the inclusion of various groups, starting with an exploration of gender inclusion before expanding to cover broader marginalized communities (Aman et al., 2024; Cavallo et al., 2018). By critically assessing the current literature, the study seeks to sketch a mapping of the existing landscape surrounding EEs and inclusion, thus providing a foundation upon which future research can build.

2. Theoretical Background

The significance of EEs lies in their capacity to foster innovation and economic growth through interconnected networks of actors, resources, and policies (Koniakou et al., 2024). EEs are increasingly recognized as complex systems influenced by a multitude of internal and external factors, with diverse stakeholders playing a dynamic role in shaping these environments (Fredin & Lidén, 2020; Wurth et al., 2021). Within this context, the concept of inclusion emerges as a crucial consideration, serving as a foundational element for maximizing the potential of varied entrepreneurial contributions. Inclusion refers to equitable access to resources, opportunities, and support for all individuals, particularly those from marginalized or underrepresented groups, such as women, immigrants, and individuals with disabilities (Kansheba & Wald, 2020).

Despite the general acknowledgment of its importance, the varying definitions, dimensions, and frameworks proposed reflect the multifaceted nature of inclusion and contribute to conceptual ambiguity and hence a common understanding of what inclusion represents within EEs remains elusive (Jansen et al., 2014; Krischler et al., 2019). The conceptualization of inclusion is intricate and multifaceted, often varying significantly across different academic and policy discourses (Brix et al., 2022; Krischler et al., 2019). It has been noted that operational definitions of inclusion often focus on participation, overlooking broader social dimensions and systemic barriers that inhibit access for many individuals (Kang et al., 2019; Kruger & David, 2020). Consequently, scholars argue for a more holistic understanding that encompasses both social and structural aspects of inclusion (Cantner et al., 2021).

In terms of definition, inclusion in EEs has been defined in numerous ways by different scholars. Some researchers emphasize inclusion as the availability of resources and opportunities for traditionally marginalized groups, including women, ethnic minorities, and individuals with disabilities (Muhtar et al., 2024; Sharma et al., 2020). Others view inclusion through a relational lens, focusing on the interconnectedness of various ecosystem actors and how these relationships facilitate or hinder access to entrepreneurial opportunities (Ojeda-Beltrán et al., 2023; Prokop & Thompson, 2022). The diversity of these definitions illustrates a significant gap in unified conceptualization, which has implications for theory building and empirical research in the field (Dele et al., 2023).

Prokop & Thompson (2022) highlight that effective EEs are characterized by their "openness" and ability to include all actors. However, it remains unclear which specific factors contribute to this openness and how they can be systematically measured (Hameed et al., 2023). Furthermore, existing studies highlight a troubling trend: while EEs are designed to nurture and support innovation, they often privilege certain groups over others, perpetuating cycles of exclusion (Motoyama et al., 2021). For instance, investigations into gender dynamics within EEs indicate that women entrepreneurs frequently encounter significant hurdles in accessing essential resources and networks (Aman et al., 2024; McAdam et al., 2018). Moreover, immigrant entrepreneurs also face unique challenges shaped by their socio-economic contexts, complicating their engagement with local entrepreneurial networks (David, 2025; Duan et al., 2021).The implications of these disparities are profound, as they affect individual entrepreneurs and can hinder the overall resilience and capacity of the ecosystem to innovate (Roundy, 2016). As a result, addressing inclusivity within EEs necessitates tailored interventions that recognize and tackle the unique challenges faced by underrepresented groups (Judijanto et al., 2024; Mumbire, 2024).

In this context, the call for inclusion is not merely about increasing participation; it emphasizes the need for multifaceted engagement rooted in social equity and justice (Bernstein et al., 2019). This notion aligns with recent calls to reevaluate the metrics within EEs, advocating for frameworks that prioritize the inclusion of diverse perspectives as a catalyst for innovation and sustainability (Bouncken & Kraus, 2021; Brix et al., 2022). Moreover, including diverse voices in decision-making processes is critical to creating EEs that genuinely reflect

and address the needs and aspirations of all stakeholders, thus enhancing their dynamism (Brito & Leitão, 2020; Roundy et al., 2017).

3. Methodology

A SLR was conducted to identify the contemporary academic understanding around the inclusion in EEs. Systematic methods were used to point out the status of inclusion in EEs, by exploring various inclusion streams. In addition, an extensive database of relevant articles was compiled to guide this research process and outcome. The methodological quality of the included systematic review was assessed with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA2020) Statement (Sarkis-Onofre et al., 2021).

3.1 Question Formulation

The research question that was raised in this study was "How current literature addresses inclusion in the context of EEs". This question was raised due to the need for a literature review in this area (Snyder, 2019). Moreover, it initiates an exploration focusing on the status of academic understanding on inclusion in contemporary EEs, on framing the under-researched topics, and on highlighting the under-represented groups in EEs.

3.2 Applying the PRISMA2020 Protocol and Articles Reviewing

In this SLR, PRISMA2020 Protocol guided the research findings to minimize bias and the validity of the review (Mengist et al., 2020). More specifically, it was a road map for describing what was done, what was found, reviewing the data results by setting inclusion and exclusion criteria while it's provided the framework to report the data (Sarkis-Onofre et al., 2021b). In this work, the complete applied PRISMA's protocol process steps included through identification databases and results, eligibility, inclusion and exclusion criteria, screening articles and final records result. Figure 1 summarizes the document review process which is detailed in the following subsections.

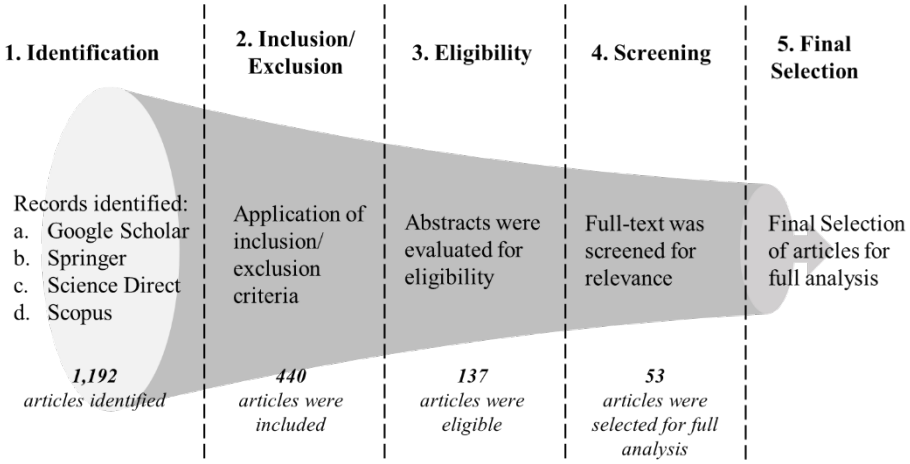


Figure 1: Document Review Process

3.2.1 Sources

Multiple sources and databases were used in this SLR. Google Scholar, journals like Springer, and ScienceDirect were resources to explore and review articles.

3.2.2 Search Strategy

Identified key words and searched for terminology to find appropriate articles. The search string applied in databases used the search terms "inclusion", "social inclusion", "inclusivity", "entrepreneurial ecosystem", "inclusive entrepreneurial ecosystem", "inclusive entrepreneurship", "gender in entrepreneurial ecosystem", "exclusion", and "discrimination". The selected articles were exported in the areas of Business Management, Entrepreneurship, Social and Political journals, sites and conferences.

3.2.3 Identify Inclusion and Exclusion Criteria

The search was framed by the following criteria: (i) Time period (Since 2014), (ii) Language (English), (iiI) Publication type (research reports, journal articles, conference proceedings, reports from EU and international bodies), and (iv) Study design (desk research, survey, consultations, EU guidelines and Directives, conferences).

3.2.4 Screening Process-Eligibility

In the eligibility phase, the abstracts were analyzed first making selections and then full-text articles were read making the final selection (Snyder, 2019). Regarding reducing the risk of selection errors or bias, two reviewers screened the results. Both reviewers (i) had a good knowledge of the topic, (ii) had a thorough understanding of the inclusion and exclusion criteria developed in the review protocol (iii) screened independently to avoid influencing each other as they worked. Through this eligibility procedure, 1192 articles were excluded and 53 were analyzed.

3.2.5 Data Export, Organizing and Analysis

The final phase included data export, organizing and analysis. In this phase a Synthesis Matrix, was developed to track notes, overview the literature, and assure the accuracy of the data by verifying its reliability. Following this process, specific results were obtained for a more focused analysis later and future research areas were suggested.

4. Results

4.1 Literature Review: Analysis

The concept of Inclusive Entrepreneurial Ecosystems (IEEs) gained traction, with various academic and policy-oriented programs discussing the importance and practices regarding inclusion in EEs. The International Labour Organization (ILO) published a report highlighting the need for holistic strategies to support entrepreneurs from all backgrounds(International Labour Organization (ILO), 2024)

The analysis shows that reviews of inclusion and EE studies accept IEEs as an upcoming research stream. As an upcoming theoretical stream, IIEs have been explored by researchers through conceptual methods. Hence, several articles analyze the concept of IIEs and set theoretical frameworks. Thus, longitudinal studies are essential for answering questions of this field and for understanding the impact of space and time on them (Cho et al., 2022). There is also an increasing interest in constructing an IEE Index by utilizing platforms from globally recognized databases to enhance understanding and support future empirical investigation of them(Hameed et al., 2023).

IEEs are designed to provide equitable opportunities for all, regardless of gender, socioeconomic status, or other potentially marginalizing factors(Stam Erik, 2016). However, several persistent gaps hinder the realization of truly IEEs. These include structural and cultural biases to networks and resources for underrepresented groups, and insufficient policy support(ILO, 2024; Brush et al., 2019). Drawing from recent scholarship, the following gaps have been identified and discussed in relation to gender, governance, and systemic inequality within EEs.

Regarding gendered disparities, women entrepreneurs frequently face structural barriers in accessing and leveraging entrepreneurial networks, which are critical for acquiring resources, gaining legitimacy, and scaling ventures(C. Brush et al., 2019). Research shows that women possess less social capital than men within EEs and often encounter gender perceptions that undermine their credibility and legitimacy, especially in male-dominated settings (Xaver Neumeyer et al., 2019). These challenges limit their ability to engage in the reciprocal exchange of support and information, further marginalizing them from key opportunities within the ecosystem (Lene Foss et al., 2019). Consequently, many networks inadvertently perpetuate inequality by privileging dominant actors and norms.

In addition, the persistent underrepresentation of women and other marginalized groups in decision-making roles such as in venture capital firms, startup incubators, and policymakers, has significant implications for the inclusivity and functioning of EEs. The imbalance contributes to biased funding decisions, limited access to strategic resources and the perpetuation of gender power structures within ecosystem (C. G. Brush et al., 2017; DANA KANZE et al., 2017). Research indicates that decision-making bodies with greater gender diversity are more likely to recognize the potential of women-led ventures and allocate resources more equitability (Gry Agnete Alsos et al., 2013).

Additionally, EEs in many regions remain fragmented due to lack of coordination, collaboration, and information sharing among key stakeholders. This fragmentation disproportionately affects entrepreneurs from marginalized backgrounds who rely on intermediary institutions for access to resources and support(Isenberg, 2010; Stam, 2015).

Moreover, IEEs frequently fail to address the deep-rooted cultural and institutional barriers that hinder participation by underrepresented groups. Societal norms, gendered expectations, and structural discrimination shape the ways in which opportunities, legitimacy, and resources are distributed(Helene Ahl & Susan Marlow, 2012). These barriers are embedded in policy frameworks, funding practices, and informal norms, often leaving women, migrants, and minority entrepreneurs with limited access to support structures or influential networks (C. Brush et al., 2019; Kwong et al., 2019). Despite growing recognition of the need for IEEs, many national policy initiatives remain inadequate in scope and impact. Often, these policies are poorly resourced, disconnected from ecosystem needs or too narrowly focused on symptom-based interventions without addressing structural inequalities (Lene Foss et al., 2019). The OECD describes many women-focused entrepreneurship policies as "fragile, time-limited, small-scale, sparse" highlighting the need for more holistic and systemic approaches(OECD/European Union, 2017). Without disaggregated data by gender, ethnicity, disability, or migration status, policy makers and ecosystem designers cannot effectively assess the inclusivity or impact of their interventions(ILO, 2024). Both OECD and ILO emphasize that stronger evidence-based evaluation practices are critical for improving policy design and ensuring that inclusive practices are scalable and transferable (ILO, 2024; OECD/European Union, 2017).

5. Discussion and Future Research

5.1 Main Dimensions Framing Inclusion in EEs

Examining the literature through this SLR process reveals several key dimensions that frame inclusion, each of which contributes to a comprehensive understanding of how diverse participants interact within these ecosystems (Figure 2).

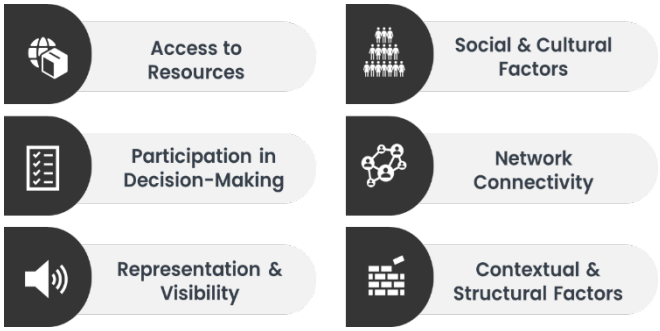


Figure SEQ Figure * ARABIC 2: Dimensions Framing Inclusion

5.1.1 Access to Resources

One of the primary dimensions of inclusion in EEs is access to resources, which encompasses financial, social, and informational capital. Yeasmin & Koivurova (2019) emphasize the importance of recognizing sustainable opportunities for immigrant entrepreneurs, suggesting that access to capital is significant for business success. This encompasses not only financial resources, such as startup capital and microloans, but also access to mentorship, networks, and educational resources that are critical for developing entrepreneurial capabilities.

5.1.2 Participation in Decision-Making

Participation in decision making involves empowering diverse actors to have a voice in shaping the policies, programs, and initiatives that govern the EE. Inclusion is achieved when marginalized groups can influence decisions that impact their entrepreneurial experiences (Kang et al., 2019). The active involvement of various actors enhances resource sharing and knowledge exchange, which is vital for the success of entrepreneurial ventures (Belitski et al., 2021; Cavallo et al., 2018). Furthermore, inclusive networks can significantly enhance participation in decision-making processes, ensuring equitable representation and access to resources (Aman et al., 2024; Duan et al., 2021).

5.1.3 Representation and Visibility

Representation within the EEs is critical for fostering an inclusive environment. This dimension highlights the need for diverse demographic groups to be visible in entrepreneurial activities, leadership roles, and success stories (Orser et al., 2019). The absence of representation can perpetuate biases, undermining efforts to build inclusive culture (Bruin et al., 2022). Ultimately, enhancing representation requires targeted actions to dismantle systemic barriers and foster inclusive practices (Cantner et al., 2021; Kang et al., 2019).

5.1.4 Social and Cultural Factors

Factors such as societal norms, attitudes toward entrepreneurship, and cultural barriers can significantly affect the experiences of marginalized entrepreneurs. For immigrant entrepreneurs, their embeddedness in local social networks is crucial for recognizing sustainable opportunities and overcoming barriers to business initiation (Duan et al., 2021; Yeasmin & Koivurova, 2019). Furthermore, the relational dynamics (Spigel, 2017) show that the sociocultural context determines the efficacy of networks and resource flows, which are critical for entrepreneurial success (Duan et al., 2021). Understanding these social dynamics is essential for developing inclusive policies that resonate with the diverse cultural backgrounds of entrepreneurial actors.

5.1.5 Network Connectivity

Network connectivity refers to the degree to which actors can establish relationships and engage with others within the EE. Strong networks are essential for resource sharing, knowledge exchange, and support systems that facilitate entrepreneurial growth. Enabling this connectivity empowers the broader socio-economic landscape by ensuring diverse participation and inclusion within the entrepreneurial community (Cantner et al., 2021; McAdam et al., 2018) as barriers can lead to social exclusion and a lack of opportunities for marginalized entrepreneurs (Aman et al., 2024).

5.1.6 Contextual and Structural Factors

Contextual and structural factors, including geographic location, socio-economic conditions, and regulatory environments, also play a significant role in shaping inclusion in EEs. The concept of mixed embeddedness highlights how local contexts can affect the entrepreneurial opportunities available to marginalized groups (Aman et al., 2024; Bouncken & Kraus, 2021). Differences in institutional quality and the availability of supportive infrastructure can create unequal opportunities for entrepreneurship (Fredin & Lidén, 2020). Additionally, inclusivity requires adaptive institutional frameworks that respond to the specific needs of different groups, thereby creating a more equitable and dynamic ecosystem (Orser et al., 2019). The interplay of these factors ultimately determines the inclusivity and sustainability of EEs (Kang et al., 2019). Tailoring strategies to the local context is essential (Brix et al., 2022).

5.2 Research Gaps

While the above dimensions provide critical insights into framing inclusion within EEs, the literature reveals challenges related to the lack of a common understanding of what inclusion truly means. The various definitions and conceptualizations contribute to ambiguity and can hinder consistent policy application and empirical investigation. In this context, this work identifies a set of gaps that researchers can focus on to enhance our understanding of inclusion within EEs.

5.2.1 Empirical Evidence on Inclusivity Practices

One notable gap is the lack of extensive empirical research investigating the effectiveness of specific practices across diverse EEs. Although certain studies provide preliminary insights into how marginalized groups navigate entrepreneurship, such as female or immigrant entrepreneurs, there remains a scarcity of comprehensive datasets that systematically analyze these experiences (Aman et al., 2024; Yeasmin & Koivurova, 2019). Furthermore, studies investigating the effectiveness of targeted programs for diverse groups could benefit from longitudinal research examining the long-term impacts of such programs on entrepreneurs' sustainability and growth (Orser et al., 2019).

5.2.2 Theoretical Framework Development

Most existing research tends to focus on anecdotal evidence or case studies without adequately grounding their findings in robust theoretical frameworks, leading to the concept being under-theorized (Cantner et al., 2021; Kansheba & Wald, 2020; Wurth et al., 2021). Moreover, more comprehensive theoretical models that integrate cultural, socioeconomic, and geographical factors impacting inclusivity in entrepreneurship are needed to fully understand how to foster equitable EEs across different regions.

5.2.3 Intersectionality and its Implications

Another critical gap is the need for an intersectional understanding of IEEs, which takes into consideration the complex identities that influence entrepreneurial outcomes. Most studies tend to examine demographic factors, in isolation without accounting for how the intersection of these identities shapes entrepreneurial experiences (Brixiová et al., 2020; Cavallo et al., 2018). Research has shown that the challenges faced by a female Latina entrepreneur may differ significantly from those encountered by a male African American entrepreneur (Kang et al., 2019). This highlights the need for frameworks that can effectively analyze the interplay of multiple identity factors.

5.2.4 Focus on Marginalized Populations Beyond Gender and Ethnicity

While studies have significantly focused on women and ethnic minorities, our research has identified that other marginalized populations, such as individuals with disabilities and LGBTQ+ entrepreneurs, have received far less attention. More research is needed to understand the specific barriers these groups face within EEs.

5.2.5 Measurement and Assessment Frameworks

There is a notable absence of standardized frameworks for measuring inclusivity within EEs. Current metrics are often qualitative, lacking the quantitative underpinnings that can produce robust assessments of inclusive entrepreneurship initiatives (Bernstein et al., 2019; Johnson et al., 2022). Comprehensive measures are needed to assess the output (e.g., number of businesses started) but also the depth of inclusion (e.g., support for diverse groups). Such frameworks would enable better comparisons and help establish best practices grounded in evidence.

6. Conclusion

In this SLR, the current state of art regarding inclusion-with particular emphasis on gender dynamics- within EEs was explored. The concept of inclusion in EEs is shaped by a complex interplay of structural, institutional, socio-cultural and individual-level factors. These determine to extent to which underrepresented entrepreneurs (such as women, ethnic minorities, persons with disabilities, and others) can access, participate in, and benefit from EEs.

Through a comprehensive examination of literature, this work delineates the foundational dimensions of while also uncovering notable conceptual and empirical deficiencies. By integrating these insights, this study advances the development of a more robust and theoretically grounded framework for inclusion in EEs and proposes key trajectories for future scholarly inquiry.

Ethics Declaration

We declare that this material is the authors' own original work, which has not been previously published elsewhere. Ethical clearance was not required for this research.

AI Declaration

We acknowledge the use of ChatGPT (model 04-mini) to proof-ready our own work. This work pasted into ChatGPT with the instructions to "Identify in this essay the typos and grammatical errors, repeated words or rephrase sentences, and all unnecessary adverbs" to detect errors.

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Experience With Artificial Intelligence and Attitudes Towards Social Media Copywriting

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Abstract: Artificial Intelligence (AI) is one of the most discussed phenomena in social media marketing communications today. Its application offers extensive possibilities for streamlining the production of media and advertising texts, thus fundamentally changing the established methods of work of marketers. The present study investigates how individual experience with different AI technologies influences users' attitudes towards the prospectivity of AI in copywriting in the digital environment. Specifically, three areas of AI technologies were analysed: generative AI tools, natural language processing (NLP), and machine learning (ML). Data for this study was collected through quantitative research via an online questionnaire, with a total of 1308 respondents from different age and social groups. It was hypothesized that experience with these technologies would significantly influence respondents' attitudes towards the use of AI in marketing communications. Statistical analysis (chi-square tests and multinomial logistic regression) confirmed these hypotheses. Respondents who had direct experience with generative AI tools, NLP or ML technologies demonstrated statistically significantly more positive attitudes towards the application of AI in content creation. However, the overall frequency of use of AI technologies had the strongest effect on positive expectations. Thus, the results point to the fact that more interaction with AI increases trust and acceptance of its applications in marketing. The findings of the study have important implications for practice. Marketers and social media managers should emphasize actively engaging customers in interactions with AI technologies, which can increase their positive perceptions of AI-generated content. The paper also discusses the limitations of the research and suggests future directions for further study, recommending a combination of quantitative and qualitative methods to gain deeper insights. The study contributes to the academic debate on the importance of understanding consumer attitudes when implementing AI in digital marketing.

Keywords: Artificial Intelligence, Social Media, Copywriting, Generative AI Tools, Natural Language Processing, Machine Learning

1. Introduction

Over the last decade, social media has played an increasingly fundamental role in transforming the way we communicate, educate, do business, as well as political and social interactions. The use of Artificial Intelligence (AI) has played a significant role in this evolution, as technological advances have made it possible to create, analyse, and distribute digital content more efficiently than ever before (Elkhatat et al., 2023). One of the areas where AI is making significant inroads is in the field of marketing communications and media content, specifically copywriting. AI in copywriting can generate texts that are optimized to capture the attention of the audience, increase interactions, and maximize marketing effectiveness (Noy & Zhang, 2023). While the benefits lie primarily in automation, scalability, and the ability to efficiently analyse social media user behaviour, it simultaneously opens up a debate about the quality, originality, and credibility of the content generated in this way (Zachlod et al., 2022). In the context of social media and digital marketing, a popular AI tool is the use of generative AI tools. Generative AI tools provide automated communication interfaces on social media platforms, serving not only for customer support, but are also capable of personalizing marketing campaigns, capturing valuable data on customer behaviour, and targeting consumers with high precision (Kshetri et al., 2024). This aspect is in line with the intention to identify the implications of the use of social media in different social and economic areas. Other relevant areas of AI in the context of social media are Natural Language Processing (NLP) and Machine Learning (ML). NLP enables real-time analysis of social media users' attitudes, sentiment and trends, providing marketers with instant feedback on the content created (Arbane et al., 2023). Machine learning, in turn, provides efficient processing of the vast amount of data that users generate through their daily activity on social platforms, helping to predict trends and personalize communication strategies (Kang & Lou, 2022). Despite the many positive applications of AI in social media, there are concerns about potentially negative aspects such as digital manipulation, misinformation, or loss of authenticity in communication. In this context, it is imperative to explore consumer and practitioner attitudes towards the use of AI technologies in media and marketing communications, particularly in the context of social media (Ashtiani & Raahemi, 2023). The present study seeks to elucidate the link between social media users' past experiences with selected AI technologies (generative AI tools, natural language processing and machine learning) and their attitudes towards the future use of AI in marketing copywriting.

Based on the above, we set the following research question:

How does respondents' experience with AI technologies (generative AI tools, natural language processing and machine learning) influence their perception of the prospects for using AI in social media marketing copywriting?

From this research question, the following hypotheses were formulated:

H1: Experience with generative AI tools has a statistically significant effect on the perception of the prospect of using AI in marketing copywriting.

H2: Respondents' experience with natural language processing has a statistically significant effect on their perception of the prospect of using AI in marketing copywriting.

H3: Experience with machine learning has a statistically significant effect on perceptions of the prospect of using AI in marketing copywriting.

2. Methods

A quantitative research strategy was chosen for the purpose of the present research, which aimed to investigate the impact of respondents' experiences with selected AI technologies (generative AI tools, natural language processing and machine learning) on their perceptions of the prospects for using AI in social media marketing copywriting. This approach allows the relationships between variables to be systematically investigated and the stated hypotheses to be objectively tested through statistical methods (Liu et al., 2023). The primary data collection tool was a questionnaire that was created online. The survey was distributed online via Google Forms, using social media platforms, email invitations, and research group mailing lists. The questionnaire consisted of closed-ended questions that allowed for a clear definition of the respondents' attitudes, experiences, and opinions in relation to the topics of AI and its applications in marketing communications. The questionnaire was designed to contain simple, easy-to-understand questions and scales to minimize the possibility of ambiguous answers and to ensure high validity and reliability of the data obtained. The structure of the questionnaire included the following main areas of demographic data such as gender and age. Subsequently, it was the frequency and type of experience with AI. As well as experience with specific AI technologies (generative AI tools, natural language processing, machine learning), then attitudes towards the prospect of using AI in the field of marketing communications, specifically in copywriting, and an overall assessment of the impact of AI on future marketing communications strategies on social media. The research was conducted through random selection of respondents. The sampling method was chosen due to its effectiveness in online data collection, while allowing for reaching a wide target group of social media users with varying experiences with AI. The total research sample size was 1308 respondents, and after data checking and cleaning, between 1276 and 1308 valid responses were included in the final analyses, depending on the variable under study. The age structure of the respondents included those aged between 18 and 79 years, which ensured that the results were representative across a range of ages and experiences. The data obtained were processed and analysed using IBM SPSS statistical software. Chi-square test of independence analysis was used to test for relationships between categorical variables to determine the statistical significance of differences in respondents' opinions according to their prior experience with AI technologies (generative AI tools, NLP, ML) and AI-based copywriting perspectives. The significance level was set at $p < 0.05$ by default (Kwak, 2023). Subsequently, multinomial logistic regression was applied to assess the more comprehensive influence of the variables under study on the perceived prospectivity of AI in content marketing. Multinomial logistic regression provided a more detailed view of the interrelationships and enabled the identification of the most significant factors influencing respondents' attitudes towards the future use of AI in social media marketing communications. All relevant ethical principles were adhered to during the conduct of the research. Participation was voluntary and respondents were informed of the purpose of the research and the anonymity of their responses. The data collected was processed solely for the purposes of the above research and in accordance with the General Data Protection Regulations (GDPR).

3. Results

This section presents the results of a quantitative research study that aimed to verify the relationship between respondents' experiences with AI technologies (generative AI tools, natural language processing, machine learning) and their perceptions of the prospective use of AI in marketing copywriting. The results are structured according to each hypothesis, with interpretations added.

Table 1: Relationship between experience with generative AI tools and perception of AI in copywriting

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	59,877	1	<,001		
Continuity Correction[b]	58,894	1	<,001		
Likelihood Ratio	58,277	1	<,001		
Fisher's Exact Test				<,001	<,001
Linear-by-Linear Association	59,831	1	<,001		
N of Valid Cases	1308				

Chi-square analysis (Table 1) confirmed a significant relationship between respondents' experience with generative AI tools and positive perceptions of the prospectivity of using AI in copywriting ($\chi^2 = 59.877$; df = 1; $p < 0.001$). Respondents with experience with generative AI tools were more likely to have positive perceptions of the prospectivity of AI in content marketing. The result confirms hypothesis H1.

Table 2: Relationship between experience with NLP and perception of AI in copywriting

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	25,000	1	<,001		
Continuity Correction[b]	24,148	1	<,001		
Likelihood Ratio	23,690	1	<,001		
Fisher's Exact Test				<,001	<,001
Linear-by-Linear Association	24,980	1	<,001		
N of Valid Cases	1276				

The results of the chi-square test (Table 2) showed a statistically significant relationship between respondents' experience with natural language processing (NLP) and positive perceptions of the prospectivity of AI in marketing copywriting ($\chi^2 = 25.000$; df = 1; $p < 0.001$). Respondents who had experience with NLP showed significantly more positive attitudes toward AI copywriting, which supports hypothesis H2.

Table 3: Relationship between experience with ML and perception of AI in copywriting

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	27,336	1	<,001		
Continuity Correction[b]	26,342	1	<,001		
Likelihood Ratio	25,635	1	<,001		
Fisher's Exact Test				<,001	<,001
Linear-by-Linear Association	27,315	1	<,001		
N of Valid Cases	1308				

The Chi-square test (Table 3) showed a significant association between respondents' experience with machine learning (ML) and positive evaluation of the prospectivity of using AI in marketing copywriting ($\chi^2 = 27.336$; df = 1; $p < 0.001$). Respondents with prior experience with machine learning showed greater optimism towards using AI in marketing copywriting, which supports hypothesis H3.

Table 4: Multinomial. Logistic regression

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
The Intercept	192,739[a]	,000	0	.
generative AI tools	219,923	27,185	2	<,001
language processing	194,335	1,597	2	,450
machine_suffusion	195,095	2,357	2	,308
frequency_ai	250,487	57,748	8	<,001

The results of the multinomial logistic regression (Table 4) showed a statistically significant effect of experience with generative AI tools ($p < 0.001$) on respondents' expectations of the impact of AI on marketing content. In contrast, experience with natural language processing ($p = 0.450$) and machine learning ($p = 0.308$) proved to be insignificant. The most significant factor influencing positive perceptions of AI perspectives in marketing communications was the frequency of use of AI technologies ($p < 0.001$).

4. Discussion

The results of the present research provide several valuable findings that add significantly to the existing debate on the use of AI in social media and marketing communications. The significance of the relationship between respondents' experiences with various AI technologies (generative AI tools, natural language processing, and machine learning) and positive evaluations of the prospect of using AI in marketing copywriting, suggests that direct interaction with AI technologies increases acceptance and positive perceptions of them. The confirmed relationship between respondents' experience with generative AI tools and positive perceptions of AI copywriting is in line with previous findings, which state that generative AI tools are an effective tool to increase users' positive attitudes towards AI in general (Bilquise et al., 2022). This may be due to the fact that generative AI tools allow users to experience direct interaction with AI, thereby reducing uncertainty and apprehension that often stems from lack of knowledge or lack of experience (Aggarwal et al., 2023). The analysis further demonstrated that respondents with NLP experience had a more positive perception of the prospect of AI in marketing communications. This finding is consistent with the arguments of authors who consider NLP technologies to be crucial for effective content personalization and communication on social media (Kshetri et al., 2024). The high level of personalization enabled by NLP may be a factor that leads to greater optimism in relation to the use of AI in content marketing. Similarly, experience with machine learning has been linked to a more positive perception of the potential of AI in marketing copywriting. The research findings are consistent with studies highlighting that ML significantly improves marketers' ability to predict customer behaviour and thus effectively optimise social media communications (Matz et al., 2024). On the other hand, a more detailed analysis using multinomial logistic regression showed that the impact of ML experience may be less direct and more strongly influenced by other factors, such as the overall frequency of AI use. The most striking result of the multinomial logistic regression is the identification of frequency of use of AI as the most significant factor influencing respondents' positive expectations of its future use in marketing. This finding confirms technology acceptance theory (Parvez et al., 2022), which emphasizes that the more frequently people are exposed to a technology, the more likely they are to begin to perceive it as useful, easy to use, and acceptable in the long run. On the other hand, the potential limitations of the findings need to be considered. The use of convenience sampling may limit the generalizability of the results, as the sample may not be fully representative of the overall population of social media users (Donaldson et al., 2022). Also, while the quantitative nature of the research allowed for statistical relationships to be verified, it did not provide deeper qualitative insights into the reasons and motivations behind respondents' attitudes. Despite these limitations, the paper makes an important contribution to the debate by providing new evidence of the positive impact of practical experience on the acceptance of AI in social media and marketing. For further research, we recommend the use of combined methodologies that could provide a deeper qualitative understanding of users' opinions and attitudes and thus enrich the discussion on the prospective use of AI in marketing communications.

5. Conclusion

The presented research analysed the relationship between respondents' experiences with specific AI technologies (generative AI tools, NLP, ML) and their attitudes towards the prospect of using AI in social media marketing copywriting. The results confirmed all stated hypotheses (H1, H2, H3) and showed that practical experience significantly increases positive perceptions of AI as a prospective tool for marketing content creation. However, the most significant factor of positive expectations turned out to be the frequency of use of AI technologies. From a practical perspective, these results suggest that social media firms should actively engage customers in interacting with AI technologies, which can increase their trust, positive attitude, and readiness to accept AI-generated content. From a theoretical perspective, the study supports the validity of technological acceptance in the context of AI and marketing communication. Future research should incorporate qualitative approaches to further explore users' views and motivations and should also consider broader socio-economic and cultural factors that may influence attitudes towards AI in different regions or segments of the population. Consistent with the theme that AI is likely to continue to play a key role in transforming marketing communications on social media, and that its effective use requires continuous building of trust and understanding among users.

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Ethics Declaration

This research did not require ethical approval. All participants provided informed consent for the use of their responses for research purposes.

AI Declaration

No AI tools were used in the creation of this paper.

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Low-threshold Help for Students Entrepreneurship

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Abstract: Low-threshold help refers to supporting students in their own strengths on their own terms. Higher education students should be able to try entrepreneurship in a genuine realistic context, so that their knowledge and skills would accumulate for future entrepreneurship. It is important that entrepreneurs come from as diverse backgrounds as possible. Future entrepreneurs will show what our world will be like. If innovations and entrepreneurship are limited to a certain homogeneous group of young people, our world and our future companies will become very uniform. This was a case study on the entrepreneurial enthusiasm of university students in the LUT group in South Karelia. The data for this study was based on the results of a student survey conducted at LUT group in 2024, based on which obstacles to entrepreneurship were identified. In addition, six (6) students with an entrepreneurship or team learning orientation were deeply interviewed for the study. Of the respondents to the student survey (n 141), as many as 63% saw entrepreneurship as a possible career option in the future. However, students still need a lot of support for entrepreneurship. More and more respondents reported that they do not have a business idea to develop. Fear of failure was also identified as an obstacle based on the interviews. It can be difficult for a student to see themselves as an entrepreneur and recognize their own entrepreneurial readiness, unless they receive support in the process. The perception of one's own ability also reflects the courage to try and innovate new things.

Keywords: Student Entrepreneurship, Self-efficacy, Students Entrepreneurial Identity, Entrepreneurial Attitude

1. Introduction

For the growth of the Finnish economy, it is of paramount importance to identify the factors that either inspire or, on the other hand, slow down new entrepreneurs from starting a business.

The purpose of this study is to describe the genuine views of students on the obstacles and opportunities of entrepreneurship. Student entrepreneurship enthusiasm has been studied in Finland before, and those studies emphasize the small number of business ideas among students. The purpose of this study is to find out with a small sample whether students see entrepreneurship as a possible career path in the future and if not, whether the reason is that they do not yet have their own business idea. The data used includes previous studies measuring entrepreneurship enthusiasm, a study conducted in the fall of 2024 among LUT group students, and six (6) in-depth interviews.

In addition, the purpose of this study is to find out whether there is a service or support missing from universities that students interested in entrepreneurship need. The results of the study can be used to develop the services of the business incubator Business Mill.

2. Student Entrepreneurship in Finland

The impact of entrepreneurship on Finland is significant, at the same time as the number of jobs has decreased radically in recent years (Finnish News Agency STT 2025). In the new government program, entrepreneurship is highly valued. The government program has a vision in which the goal is a competitive, entrepreneur-friendly Finland that attracts investments:

> *"By 2031, Finland will be the most interesting country in the world to invest in and create something new. The conditions for entrepreneurship, ownership, and growth are in order, which will generate jobs, well-being, and prosperity for the citizens" (Government Program 2023).”*

From the Future Barometer (2025) conducted by Sitra, there is a strong belief in the future in South Karelia. Respondents felt that Finland has good conditions for living and entrepreneurship in the future. Respondents also believed that innovations have a significant impact on Finland's economic growth. (Sitra. 2025.) Finland has lagged in economic growth compared to other Nordic countries, partly due to the weak relationship of labor productivity. Innovations play a significant role in increasing labor productivity.

Finland traditionally has a strong understanding of craftsmanship. We are one of the few countries where nearly 500 hours of crafts are included in the basic education curriculum. Doing and experimenting with oneself has a positive impact on the ability to innovate and think creatively. (Koivula. 2025.) According to the Student Barometer (2022), nearly 37% of respondents saw entrepreneurship as a possible career option after

graduation, or they were already entrepreneurs at the time of response (Student Barometer 2022). The corresponding figure in the survey conducted at LUT universities was 63%. Student entrepreneurship enthusiasm has been high in Finland in recent years, but still, new companies are not being established among university students in South Karelia.

According to the Student Barometer (2022), the reasons why a student would want to become an entrepreneur include the opportunity to independently decide about their own work (51.1%), the opportunity to express themselves (42.6%), freedom of working hours (37.1%), the possibility of better income than in employment (31.6%), the opportunity for rewarding work (28.8%), valuing entrepreneurship (21.2%), a good business idea (13.2%), and solving societal or global challenges (11.0%). (Student Barometer 2022.)

Conversely, the reasons why entrepreneurship is not of interest include financial risks associated with entrepreneurship (63.8%), lack of a business idea (49.4%), the workload of an entrepreneur (41.7%), poorer social security for entrepreneurs compared to employees (26.7%), and uncertainty about the obligations of an entrepreneur (21.2%). (Student Barometer 2022.)

Compared to previous studies, the entrepreneurial spirit among students has increased. In 2014, 21% of those studying in higher education considered entrepreneurship as a likely or very likely career option, while in 2019 the corresponding percentage was 19%. Entrepreneurship was considered unlikely by 69% of respondents in 2019 and 65% in 2014. (Lainio 2023).

According to the 2019 "From Student to Entrepreneur" study, 33% of respondents were willing to become entrepreneurs in the future. Only 19% of the respondents to the study considered entrepreneurship a likely career option, so the willingness to become an entrepreneur was emphasized among the respondents compared to the likelihood of entrepreneurship. According to the survey, 14 percent of students feel that their studies provide good preparation for entrepreneurship and 57 percent consider entrepreneurship a good way to promote socially important issues. (Yrittäjät.)

3. Entrepreneurial Attitude and Interactive Learning

In his book Tulevaisuuden lukujärjestys (2020), Perttu Pölönen mentions that future work will require more skills that are impossible to test in a traditional exam, such as interpersonal skills, empathy, and creativity. (Pölönen. 2020.) Creativity and interpersonal skills also have a direct connection to an entrepreneurial attitude and, through that, to entrepreneurship.

In a study conducted by Saptonon and Wibowon (2018) on high school students, it was found that changes in entrepreneurial attitudes occur in a process that includes learning, experiences, interaction with the environment, and entrepreneurship education. According to their research, learning environments had a direct impact on students' entrepreneurial attitudes. (Saptonon & Wibowon. 2018.)

Even a small child learns new things best in interaction with their parents or other people. Why would this change as we age? Nowadays, technology enables us to interact with each other and the rest of the world much more agilely than before. All environments can now be learning environments. The same interactive learning also takes place in organizations. New staff are trained under the guidance of more experienced ones. In large organizations, basic things may be repeated dozens or hundreds of times a year, every time a new employee joins the company. This is not only laborious but also expensive. Nowadays, the competitiveness of organizations is measured by how quickly they can train their staff in the use of new methods or technologies. (Koivula. 2025.)

In higher education, this requires a significant role of the teacher in the design and guidance of learning processes. When implementing entrepreneurship education, the teacher should assess and then strive to remove challenges from the students' path that could affect their self-confidence, self-esteem, initiative, and risk-taking (Rabbior, 1990).

4. Self-efficacy

According to Joensuu-Salo (2020), entrepreneurship research has been conducted using three different approaches: entrepreneurial traits, entrepreneurial behavior, and entrepreneurial cognition. Cognition leads to the kind of entrepreneurial behavior an individual implements. Therefore, cognitions have recently been at the center of entrepreneurship research. Self-efficacy has been shown to be one of the most important aspects of entrepreneurial cognition.

According to Albert Bandura, experiences of success are the most important single factor in developing self-efficacy. Bandura (1997) has defined four structural factors through which self-efficacy can be developed. These are experiences of success (mastery experiences), feedback received from others (social/verbal persuasion), social comparison (vicarious experience), and individual physiological and emotional states. According to Bandura (1997), experiences of success are the most significant source of self-efficacy. Experiences of success provide the individual with information about his or her competence in the required task.

A student may find it difficult to see themselves as an entrepreneur and recognize their own entrepreneurial readiness unless they receive support in the process. The perception of one's own ability also reflects intentions to act as an entrepreneur. Self-efficacy refers to an individual's holistic perception of their own skills and confidence in their own competence. Thus, our belief in our own ability guides our thinking about how we assess our performance in a certain task. Since self-efficacy involves not only cognitive but also emotional and motivational aspects, these should be better considered in entrepreneurship studies at universities, and the growth of students into entrepreneurship should be supported and strengthened in a more holistic way, while at the same time supporting entrepreneurial self-efficacy. Entrepreneurial self-efficacy requires students to regulate cognitive, emotional, and motivational processes so that they can successfully handle upcoming problems. Entrepreneurial self-efficacy enables entrepreneurship to be chosen as one of the future career options. (Siklander, Hintikka & Eskola. 2021.)

The experience of capability does not have to be a long journey to trying entrepreneurship. Higher education students should be offered opportunities to try entrepreneurship during their studies. Through these trials, one's own experience, relationship, and perception of entrepreneurship are formed. Entrepreneurship trials carried out with limited risk can result in, for example, part-time additional income alongside studies or an alternative summer job, but equally a growth company that will employ many fellow students in the future. The most important thing is the concrete experience that I can realize a small or large dream through entrepreneurship. The student group and goal-oriented community work help in this process, creating the experience that together more can be achieved. Also, the experience of dealing with mistakes and failures can be offered during studies in a safe environment. (Siklander, Hintikka & Eskola. 2021.)

5. Methodology

This was an explorative case study (Eisenhardt (1989), Yin (2003)) utilizing both data and researcher triangulation (Denzin. 2009). The data was analysed following the principles of grounded theory (Corbin & Strauss 2008., Flick. 2009) starting with open coding phase. The connection to the theory was sought by examining the whole, interpreting, and linking phenomena to the theory used. General and recurring phenomena were sought from the material, and their relationships and connections were examined. (Ojasalo. 2018. 110–111.) Data for this study was mostly qualitative consisting of 6 theme-based interviews and the results of a survey to which 141 students responded. Thematic interviews emphasize an individual's subjective perceptions of themselves and the world (Puusa et al., 2020). With it, the interviewees' beliefs, experiences, and thought patterns can be studied. By combining the material obtained from the thematic interview and previous research, the researcher increases their understanding of the phenomenon.

It's challenging to group the respondents of the survey into one homogeneous group, as there were respondents from both the university and the vocational college. In addition, nearly all study opportunities within the LUT group were represented. Students of commerce and business administration were the most numerous (30/141).

The students deeply interviewed all represent team entrepreneurship students. Team entrepreneurship as a form of study does not directly imply a desire to become an entrepreneur after studies, but it is easy to find similarities with entrepreneurs among the students. As team entrepreneurs, students take a lot of responsibility for their own learning and studies, they are happy to give presentations to the rest of the group, they innovate new things, and they approach the future with curiosity. This description often applies to individuals who work as entrepreneurs as well as to young people studying as team entrepreneurs.

6. Results

Based on a survey and in-depth interviews, most university students in the LUT Group and indeed throughout Finland see entrepreneurship as a possible career option after their studies. The challenges identified were the same themes as those identified in the survey conducted by the Otus Research Foundation (2022). The main concerns were uncertainty about income level, workload, and the lack of a business idea.

"I have been under the impression that the workload for entrepreneurs is very high and there would be endless work. I think that after school, the focus should be on earning a steady income. At that stage, it may not be the best financial situation to start a business."

"If one feels passionate about business operations, the amount of work is certainly bearable when you enjoy what you are doing. When starting a business, there is probably just a lot to do before it starts to produce anything."

6.1 A Survey

A student survey was conducted at the end of 2024 within the LUT group, to which 141 students responded. The students do not represent a specific field of study, but respondents were obtained from both LAB University of Applied Sciences and LUT University from many different fields. As many as 63% of the respondents saw entrepreneurship as a possible career option after their studies. However, they did not know much about the entrepreneurship actors on campus and felt that they needed help and support on the path to entrepreneurship.

Out of a total of 62 open responses, 13 mentioned the need for funding, more than half (37) needed mentoring and support, and as many as 15 said they needed help to come up with a business idea or hoped for help in developing a business idea.

Examples of survey responses. What kind of support would you need to become an entrepreneur after your studies?

Table 1: Students' responses to the open-ended question in the survey study.

Idea development, investors
Financial and business idea
Ideas and planning
I need some experts who can evaluate my ideas and give me feedback to improve them in a way that those ideas can be implemented in real life.
Business ideas
Counseling how can I boost my business idea in good way. How to be a successful entrepreneur
Financial
Business startup support in reviewing my business plan and Startup funds

The above presents open responses from students to the survey question: What kind of support would you need to become an entrepreneur after your studies? The same themes are emphasized in the responses as in the survey conducted by the Otus Foundation for Study and Education Research (2022) (Student Barometer 2022).

Based on the survey, it appears that students lack their own business ideas.

6.2 The Interview Rounds

In-depth interviews asked six (6) students about their thoughts on entrepreneurship. What kind of obstacles and opportunities they see in entrepreneurship and whether support measures could be enhanced to provide them with better tools for entrepreneurship. Courage, or rather the lack thereof, was seen as one of the barriers to entrepreneurship. But the interviews also highlighted the lack of a business idea and financial instability. The choice of their own study path seemed to support their entrepreneurship for almost all (5/6) and the interviewees did not recognize the need for change.

In the interviews, it was initially asked whether entrepreneurship has emerged as a career option and 100% of respondents (6/6) responded that they see entrepreneurship as a career option in the future. This was to be expected, as all the interviewees were either from team entrepreneurship or entrepreneurship training programs.

Then they were asked what obstacles they see to not setting up their own business after graduation. All respondents mentioned the financial situation as an obstacle to entrepreneurship. Some meant securing their own finances, for example with a salary, and others, on the other hand, meant the instability of the general world economic situation with their answer. However, all answers were united by the idea that setting up your own business initially cannot provide the necessary livelihood. They thought that work should be done first and

money should be collected from salaried jobs before setting up their own business. Entrepreneurship was not yet seen as part-time or part-time alongside salaried work.

Table 2: Responses to the in-depth interview of students.

Entrepreneurship can seem risky, and the fear of failure may prevent many from taking steps to start their own business. Students may feel that they are not ready to take big risks or that failure could affect their future opportunities.
The lack of courage may be due to culture. In my opinion, school before university of applied sciences has also not encouraged entrepreneurship.
Perhaps it is thought that a business idea should be something that has not yet been invented.
If one hasn't considered things from an entrepreneurial perspective, they might not notice the opportunities that are around them.
There is not enough information about entrepreneurship.
Students may not believe that they could build a successful company themselves, so they don't even try anything else. Good examples are missing from this area.

The table above describes the responses from student interviews about the obstacles to starting a business or developing a business idea. Courage, lack of examples, fear of failure, and hopelessness stand out in the responses. Based on the interviews, it's not that the students don't have a business idea, but they themselves do not believe that the idea is profitable or that it could secure a sufficient livelihood for them. The respondents could not name a single measure that would support the emergence of innovative ideas, but they highlighted the risks and lack of courage.

7. Conclusions

Self-efficacy has been found to have a significant impact on students' entrepreneurial enthusiasm and attitude (Siklander, Hintikka & Eskola. 2021. Joensuu-Salo 2020), while experiences of success are in turn the most important single factor in developing self-efficacy (Bandura 1977). Therefore, higher education institutions should invest more in supporting entrepreneurial trials in the future.

Although the entrepreneurial attitudes of higher education students are at a higher level than in previous years, only a few of them end up as entrepreneurs. Insufficient entrepreneurial self-efficacy may explain this phenomenon. Entrepreneurial self-efficacy refers to a student's perceptions of their abilities to succeed in work tasks requiring entrepreneurial skills, especially in challenging situations or in the role of an entrepreneur. (Siklander, Hintikka & Eskola. 2021.)

Based on a survey, students lacked a business idea, but interviews revealed that what was missing was the courage to try. Their own idea does not seem credible for starting a business if the student has a weak experience of self-efficacy. In addition, financial uncertainty creates a feeling of great risk.

Entrepreneurship is always a risk, you can either succeed or fail, but the future world of work will become fragmented and entrepreneurial skills will also be required from employees. To help students grow their entrepreneurial skills and enthusiasm, higher education institutions should invest in learning environments and a culture of experimentation. An entrepreneurial trial carried out in a low-threshold but authentic environment could strengthen students' experience of their own self-efficacy, as there is enthusiasm among students.

Below is a table of the willingness of higher education students to become entrepreneurs, collected from various statistics.

Table 3: Korkeakouluopiskelijoiden yrittäjyyshalukkuus kymmenvuoden aikajaksolla.

Year	Yes	No
2024	63%	37%
2022	34%	63,3%
2019	30,5%	67,2%
2014	21%	65%

Table 3. The 2024 figures come from a student survey conducted at LUT University, according to which 63% of respondents (approx. 141) see entrepreneurship as a possible career option in the future.

The 2022 and 2019 figures are from the student barometer and are based on the question, are you willing to work as an entrepreneur after graduation.

The 2014 figures are from Ronja Lainio's thesis from 2023 and measure students' willingness to become entrepreneurs after their studies.

The figures are not entirely comparable due to different data collection methods, respondent numbers, and question settings, but they can still indicate that entrepreneurial intention has been at a good level in recent years.

Entrepreneurial enthusiasm or seeing entrepreneurship as a possible career option, however, is a different thing than the willingness to become an entrepreneur, let alone becoming an entrepreneur. The table also gives an idea that respondents in the survey conducted at LUT universities are exceptionally entrepreneurship oriented. LUT universities have the second largest student entrepreneurship community in Finland, LUTES. LUTES is a community of over 800 student members who are enthusiastic about entrepreneurship. In Finland, a larger entrepreneurship community than LUTES is located only in Helsinki at AaltoES.

Student organizations also play a significant role in validating students' ideas and strengthening self-efficacy. Jointly organized events improve students' experience of their own skills, and in the community, at best, you get to spar your own idea with peers.

The interviewees for this study were chosen randomly, but it's important to note that their responses emphasize an enthusiasm for entrepreneurship, as they all study in a team learning format and a few of them are also part of the LUTES student entrepreneurship community. The survey was responded to by students from both universities of applied sciences and traditional universities, and their responses do not emphasize membership in the entrepreneurship community or any other uniform factor.

The study only compared Finnish surveys and also interviewed a rather homogeneous and small group of students. It would be interesting to further investigate the topic with a larger deep interview group or by comparing the results of Finnish studies with studies conducted elsewhere in Europe. In addition, the topic could also be studied by emphasizing a certain field of study. For the sake of Finland's economic growth, it would be necessary to identify the factors that students experience as hindering and promoting innovation.

Perhaps the lack of a business idea is not due to a lack of innovation, but a high-risk threshold and fear of failure. In addition to peer support and sparring, students need concrete support measures. Perttu Pölönen mentions in his book (2019) that fear of failure and too tightly set boundaries prevent children from creating new (Pölönen. 2019). For the future and the Finnish economy, however, new ways, companies, and innovations are key to development. Low-threshold support for experiments, such as offered in business incubators, should be utilized more effectively to strengthen students' business attitudes. In South Karelia, specifically in Lappeenranta, where this case study was conducted, there is a business incubator, Business Mill, available for students. None of the interviewed students had used the incubator's services. The survey also asked about the visibility of incubator services on campus, to which respondents replied that they do not know or are unaware of the incubator's services. It is not enough that low-threshold help is available, it must also be incorporated into entrepreneurship education in universities.

Ethics Declaration

The study did not require ethical declarations.

AI Declaration

An artificial intelligence (AI) tool called Future Objects has been used for checking and editing the language of the study. The AI tool has translated some of the Finnish terms and checked the spelling.

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Business and Competitive Intelligence Maturity Models Enhancing Decision-Making for Entrepreneurs: A Systematic Literature Review

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Abstract: Entrepreneurs are essential for the growth of any economy. Hence it is imperative to ensure that sufficient support functions are put into place to support entrepreneurs and their entrepreneurial initiatives. Business intelligence (BI) and Competitive intelligence (CI) enable organisations to convert raw data into meaningful insights, which significantly enhances the quality of strategic and operational decision-making, by doing so contributing to the overall sustainability of an organisation. The importance of applying BI and CI as support functions within the entrepreneurial space can contribute significantly to growth and sustainability. This study aimed to examine existing BI and CI maturity models as presented in academic literature, with the objective of identifying models that could potentially support enhanced decision-making among entrepreneurs. Through a systematic literature review, this study identified existing BI and CI models, and their adaptations, spanning over the years 2010 – 2023. Scopus was used as the database of choice due to its comprehensive coverage of academic journals, and its inclusion of a vast array of disciplines and top-quality peer-reviewed journals. The use of a PRISMA flow diagram and Mendeley ensured that the 75 articles that were identified from an initial search on Scopus, were carefully filtered through using a pre-defined inclusion/exclusion criteria. The 10 articles that complied with all the inclusion criteria for this study were then synthesised using visualisation and textual analysis. The findings of this study contribute to entrepreneurs enhancing their BI and CI capabilities through the application of various maturity models. The findings of this study also contribute to more agile and competitive business decision-making within the entrepreneurial space.

Keywords: Business Intelligence, Competitive Intelligence, Maturity Models, Decision-making, Entrepreneur

1. Introduction

In today's hypercompetitive and data-intensive business environment, organisations are under immense pressure to make informed, timely, and strategic decisions. The ability to collect, analyse, and act upon relevant intelligence has become a defining factor in achieving sustainable competitive advantage. Two pivotal disciplines, Business Intelligence and Competitive Intelligence enable this process. While BI focuses on the internal optimisation of operations through data analytics, CI provides strategic foresight by monitoring external market dynamics, competitors, and trends (Ahmad, 2015). Both disciplines can empower decision-makers, particularly entrepreneurs, to navigate uncertainty and complexity. To maximise the effectiveness of BI and CI, organisations increasingly rely on maturity models, which are structured frameworks that assess current capabilities, identify growth stages, and guide development. Business Intelligence Maturity Models (BIMMs) offer benchmarks for technological adoption, data governance, and analytical readiness, while Competitive Intelligence Maturity Models (CIMMs) evaluate an organisation's ability to systematically gather and apply external insights. The purpose of this research was to examine existing BI and CI maturity models in academic journal articles, with the goal of identifying industry-specific adaptations for enhanced decision-making by entrepreneurs. Through a systematic literature review, this study explored existing BI and CI maturity models in academic literature, for possible adaptation by entrepreneurs. By synthesising the current body of knowledge from the Scopus database between the years 2010 and 2023, this study creates an awareness for entrepreneurs to adapt existing BI and CI maturity models for decision-making.

2. Literature Review

Maturity models are structured frameworks that are used to assess the capabilities of organisations. The foundation of maturity models is rooted in the Capability Maturity Model (CMM), which was established in the 1980's by the Software Engineering Institute (SEI), at Carnegie Mellon University. The characteristics of the CMM are reflected in table 1. From the 1990's the concept of maturity models expanded into different disciplines, seeing the original CMM being adapted for various fields such as Project Management, IT governance, Human Capital Management, Business Intelligence and Competitive Intelligence (Becker, Knackstedt & Pöppelbuß, 2009). In the early 2000's SEI developed a new maturity model Capability Maturity Model Integration (CMMI) to address some of the limitations of their original CMM.

Table 1: Characteristics of CMM (SEI, 1992:18)

Maturity Level	Characteristics	Focus of Measurements
1. Initial	Ad hoc, chaotic	Establishing baselines for planning and estimating
2. Repeatable	Processes depend on individuals	Project tracking and control
3. Defined	Processes are defined and institutionalised	Definition and quantification of intermediate products and processes
4. Managed	Processes are measured	Definition, quantification, and control of sub-processes and elements
5. Optimised	Improvements are fed back to processes	Dynamic optimisation and improvement across projects

Business Intelligence and Competitive Intelligence maturity models can play a crucial role in assisting entrepreneurs to systematically build and enhance their intelligence capabilities. Business intelligence and competitive intelligence models are structured frameworks that can allow entrepreneurs to assess their current use of data and information, identify gaps, and plan for gradual improvements in intelligence practices (Popovič et al., 2012). For entrepreneurs, particularly those operating in resource-constrained or rapidly changing environments, such models are invaluable in guiding the development of both internal analytical competencies and external strategic awareness. BI maturity models can support entrepreneurs in optimising internal data usage through improved reporting, analytics, and forecasting, which leads to more informed operational and strategic decisions. Conversely, CI maturity models can help entrepreneurs evolve from reactive market responses to proactive, intelligence-driven strategic planning by improving their ability to monitor competitors, detect trends, and respond to shifts in the external environment. As these capabilities mature, entrepreneurs become better equipped to navigate uncertainty, identify new opportunities, and maintain a competitive edge. Therefore, BI and CI maturity models are not merely tools for assessment, they are developmental roadmaps that empower entrepreneurs to transition from intuition-based decision-making to structured, insight-driven strategies. Table 2 serves as a conceptualisation of the relevance of BI and CI maturity models for entrepreneurs.

Table 2: Conceptualising BI and CI maturity models for entrepreneurs (Stewart & Dewan, 2022; Madureira, Popovič, & Castelli, 2023)

Dimension	Business Intelligence (BI) Maturity	Competitive Intelligence (CI) Maturity	Relevance to Entrepreneurs
Definition	A BI Maturity model is a framework that measures an organisation's internal capabilities It measures how organisations use their internal data and analytics to drive business decisions and guides them on how to improve.	A CI Maturity Model is a framework that measures an organisations competitive intelligence capability. It helps organisations assess and improve their competitive intelligence capabilities.	Entrepreneurs need both internal BI and external CI intelligence to make well-rounded decisions.
Focus Area	BI focuses on internal operations such as, performance metrics, historical and predictive data.	CI focuses on external factors such as market trends, competitor actions, customer behaviour, regulatory shifts.	BI and CI can assist entrepreneurs to balance internal efficiency and external awareness. Through streamlining internal processes and gaining insight into external factors.
Maturity Stages	The stages of BI maturity range from a prenatal stage, where BI is used minimally all the way until full optimisation where BI is then used fully within an organisation. Leading to strategic decision-making.	The stages of CI range from a basic stage where CI is used as a reactive means all the way up to an expert stage where CI practices are highly optimized, and the focus is on maximizing the benefits.	BI and CI enables staged development for entrepreneurs with limited resources.
Decision-Making Support	BI supports data-driven decisions based on business processes	CI supports strategic decisions based on environmental scanning	BI and CI can enhance quality, speed, and confidence in

Dimension	Business Intelligence (BI) Maturity	Competitive Intelligence (CI) Maturity	Relevance to Entrepreneurs
			entrepreneurial decision-making.
Risk Management	BI identifies operational inefficiencies and forecasts trends.	CI anticipates threats from competitors and market shifts.	BI and CI can equip entrepreneurs to manage both internal and external risks.
Scalability & Growth	BI maturity indicates readiness for scaling operations.	CI maturity indicates readiness to compete in broader or more complex markets.	BI and CI can assist entrepreneurs in planning for sustainable growth.
Innovation Enablement	BI uses internal insights to refine products and services.	CI identifies market gaps and unmet consumer needs.	BI and CI drive innovation based on data and market intelligence.
Tools, Technologies and examples	BI utilises tools such as dashboards, data warehouses, predictive analytics and visualization tools. **Example:** Gartner BI Maturity Model – The Gartner BI Maturity Model provides entrepreneurs with a way to identify the level of development their BI and analytics initiative must reach, to support entrepreneurial goals.	CI focuses more on Web scraping, social listening, competitor benchmarking, SWOT analysis. **Example:** Unified Competitive Intelligence Maturity Model (UCIMM) – The UCIMM offers entrepreneurs a structured path to transform fragmented market insights into strategic, scalable, and competitive decision-making capabilities.	The tools used to implement BI and CI will be guided by the maturity level of BI or CI and the business needs.

3. Methodology

A clear roadmap of the research process is crucial to ensure the validity, reliability and credibility of research findings. This study followed a qualitative research approach, with interpretivism as the philosophical paradigm which underpinned the study. Interpretivism was chosen for this study because this study endeavoured to interpret existing BI and CI models and identify adaptations which could be utilised by entrepreneurs for decision-making. A systematic literature review was the research method chosen to address the key question of this research namely, "What are the existing BI and CI maturity models and how can they be used by entrepreneurs for enhanced decision-making"? A systematic literature review was chosen for this study to ensure transparency, reproducibility, and rigor in identifying, selecting, and synthesizing existing literature (Siddaway, Wood & Hedges, 2019). The systematic review process was guided by the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework which facilitated a structured and replicable method of data selection and reporting, illustrated in figure 1.

A carefully constructed search query, using terms such as "Business Intelligence", "Competitive Intelligence" and "Maturity Models" was developed to search for journal articles in the Scopus database. Scopus was chosen for this study due to its comprehensive coverage of academic journals, and its inclusion of a vast array of disciplines and top-quality peer-reviewed journals. The initial search on Scopus, for this study, yielded a response of 75 articles. The articles from the initial search were then filtered based on a pre-defined inclusion criteria which included the following. The articles had to be peer-reviewed, written in English and published between the years 2010 and 2023. All the qualifying articles were then exported into Mendeley Reference Manager for organisation, duplicate removal, and systematic screening by title, abstract, and full-text availability.

After the full screening process was concluded, 10 eligible articles (See table 3) were downloaded from Scopus which were then included in the qualitative synthesis of this study. Data from the 10 articles was extracted and organised using Microsoft Excel, which facilitated coding, classification, and a comparative analysis of the BI and CI maturity models. Keywords from the 10 articles were grouped together in Microsoft Excel and WordArt was used to generate the word cloud (See Figure 5). Focus was given to the models' structure, dimensions, and industry adaptations. The findings of this study were presented through visualisations generated using VOSviewer and WordArt, each supported by a corresponding narrative to contextualise and interpret the visual data.

Table 3: Articles included in systematic literature review (own source developed for this study, 2025)

Title of Article	Authors	Year
Exploring business intelligence and its depth of maturity in Thai SMEs	Boonsiritomachai, McGrath and Burgess	2016
A framework for developing a domain specific business intelligence maturity model: Application to healthcare	Brooks, El-Gayar and Samikar	2015
Business intelligence governance framework in a university: Universidad de la costa case study	Combita Niño, Cómbita, Morales and Ortega	2020
A Framework for ranking critical success factors of Business Intelligence based on the Enterprise Architecture and Maturity Model	Farshadi, Nazemi and Abdolvand	2022
Measuring the maturity of business intelligence in healthcare: Supporting the development of a roadmap toward precision medicine within ISMETT hospital	Gastaldi, Pietrosi, Lessanibahri, Paparella, Scaccianoce, Provenzale, Corso and Gridelli,	2018
The development of data analytics maturity assessment framework: DAMAF	Gökalp, Gökalp, Gökalp and Koçyiğit	2023
Business intelligence strategy: A utilities company case study	Hawking and Sellitto	2015
Toward Better Understanding and Use of Business Intelligence in Organizations	Olszak	2016
Development of a competitive intelligence maturity model: Insights from Moroccan companies	Oubricha, Hakmaouia, Bierwolfb and Haddanic	2018
Integration of big-data ERP and business analytics (BA)	Shi and Wang	2018

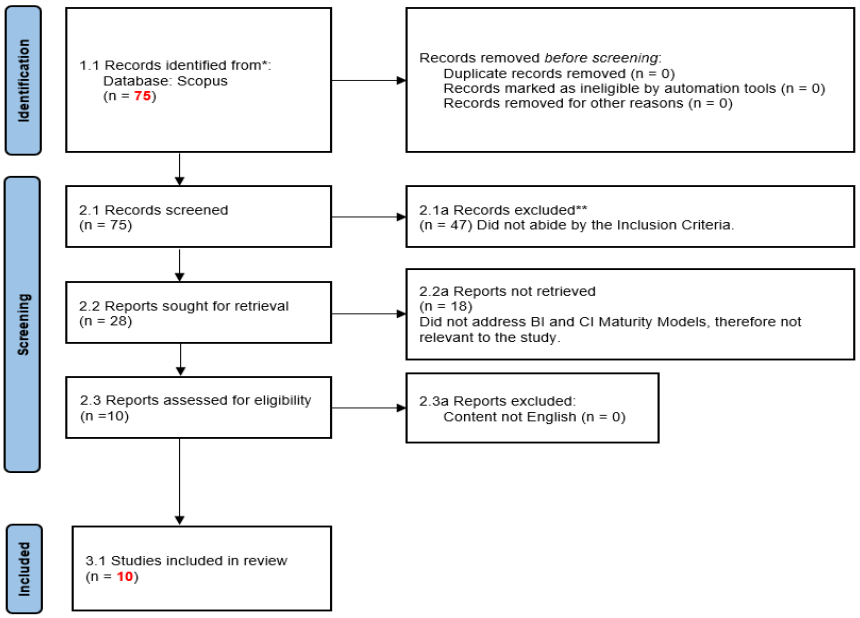


Figure 1: PRISMA Flow Diagram (own source developed for this study, 2025)

4. Findings and Discussion

This section presents a synthesis of visual and textual analysis derived from keyword co-occurrence, VOSviewer bibliometric mapping, and thematic clustering of literature on Business Intelligence, Competitive Intelligence, and Maturity Models. Each visualisation is accompanied by a narrative to highlight research patterns and thematic focus areas.

Figure 2 maps the historical evolution of research themes from 2016 to 2024. Early research focused on BI adoption and maturity model conceptualisation. Core terms such as “business intelligence”, “maturity model”, and “decision” form a dense centre, reflecting foundational concerns with analytics-driven decision-making. From 2018 onwards, research expanded toward empirical validation and sector-specific applications. CI-related terms remain less prominent, indicating a gap in model development for competitive insight. By 2022, there was a visible shift to keywords such as 'business environment' and 'business value', denoting a focus on strategic alignment and organisational impact. Technological enablers like AI, big data, and enterprise systems emerge as supporting themes. This progression shows a movement from theory-building to strategic application. The underrepresentation of CI maturity elements signals a need for integration. For entrepreneurs, these insights reinforce the value of developing internal and external intelligence maturity concurrently.

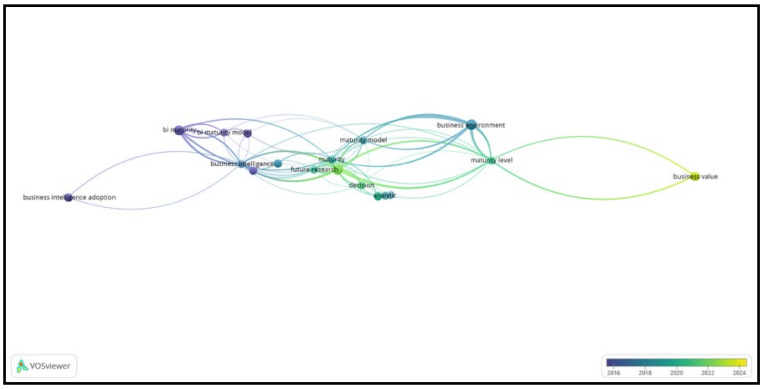


Figure 2: Overlay Visualisation of BI–CI Thematic Timeline Map: 2016–2024 (own source developed for this study, 2025)

Figure 3 presents a broader thematic map of keyword co-occurrence in BI and CI literature. BI remains dominant, supported by high-frequency terms such as 'data analytics', 'business intelligence projects', and 'enterprise architecture'. CI terms are visible but less interconnected, reinforcing their peripheral role. Health care and SMEs appear as prominent application domains, suggesting sector-specific uptake. The map reveals increasing attention to implementation, project management, and guiding principles, indicating operational maturity. Keywords like 'competitive advantage' and 'assessment framework' show that research is shifting to evaluating outcomes. Business value and strategic justification are emerging as recent focal points. AI, cognitive systems, and integration platforms indicate the role of digital transformation. Despite technological advances, CI-related maturity constructs are still underdeveloped. This highlights the need for dual-focused intelligence frameworks for entrepreneurs and strategic decision-makers.

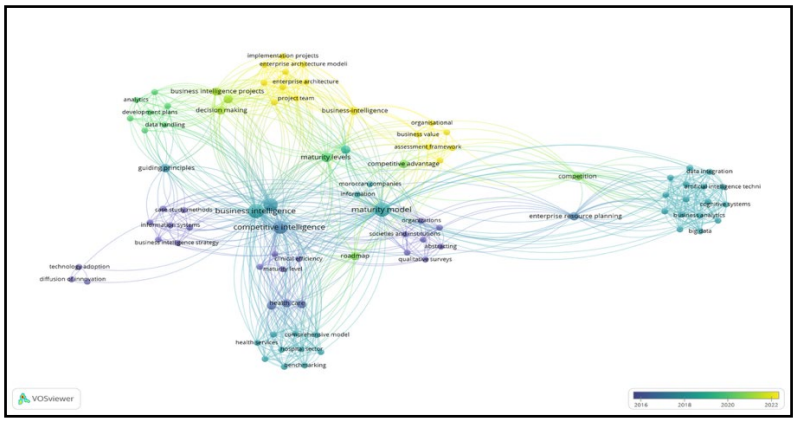


Figure 3: Comprehensive Keyword Network Map for BI and CI Literature (own source developed for this study, 2025)

Figure 4 captures the bibliographic co-occurrence of key terms between 2018 and 2021. Central to the network are the terms 'business intelligence', 'competitive intelligence', 'maturity model', and 'information analysis'. Early research (dark blue) is concentrated on defining and evaluating maturity constructs. Over time, the network shifts towards terms such as 'decision-making', 'information management', and 'business intelligence projects'. This signals a maturing field focused on application and strategic integration. Maturity levels and competitive advantage emerge as key evaluation themes. However, CI remains static in visibility, pointing to a limited bibliographic footprint. BI terms are more dynamic and well-cited, suggesting broader adoption and cross-disciplinary relevance. This reinforces the idea that CI maturity is an emergent field with development potential. For entrepreneurs, these findings advocate for intelligence systems that incorporate both internal control and external adaptability.

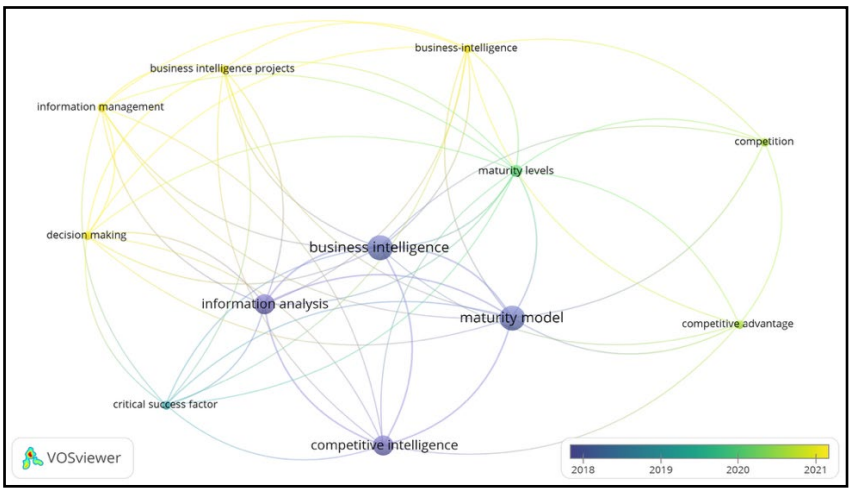


Figure 4: Bibliographic Overlay Visualisation of Keyword Occurrence: 2018–2021 (own source developed for this study, 2025)

The word cloud in Figure 5 visually highlights the prominence of key terms across the 10 academic journal articles. Dominant terms include 'Maturity', 'Intelligence', 'Business', and 'Model', indicating core conceptual interests. Clusters of related terms such as 'analytics', 'data', 'enterprise', and 'competitive advantage' show a convergence on performance and insight-driven decision-making. BI is heavily represented, while CI appears moderately and with fewer contextual terms. Critical success factors, assessment frameworks, and governance are present, suggesting a focus on strategic enablers. Health care, SMEs, and utilities emerge as key industry contexts. Methodological terms like 'qualitative surveys' and 'semi-structured interviews' reflect a qualitative research orientation. Thematic gaps include scenario planning and early warning systems under CI. This imbalance highlights the underdevelopment of competitive intelligence maturity frameworks. For entrepreneurial contexts, the word cloud reveals a growing need for integrative models that align BI and CI in pursuit of sustainable competitive advantage.



Figure 5: Word Cloud Based on Keyword Frequency from 10 Academic Journal Articles (own source developed for this study, 2025)

5. Conclusion

This study provided an overview of existing Business Intelligence and Competitive Intelligence maturity models, highlighting their relevance and application potential for entrepreneurial decision-making. Through VOSviewer bibliometric mapping, keyword co-occurrence analysis, and thematic clustering, it is evident that BI maturity models are more extensively developed and widely adopted, with a clear focus on enhancing internal data-driven capabilities, strategic alignment, and technological integration. Conversely, CI maturity models remain underexplored, signalling a critical gap in frameworks that support external insight generation, such as competitor analysis and market trend monitoring. For entrepreneurs operating in fast-paced and uncertain environments, this imbalance presents both a challenge and an opportunity. The study recommends the development of integrative BI-CI maturity frameworks that combine internal and external intelligence to support holistic, agile, and informed decision-making. Bridging this gap can empower entrepreneurs to not only optimise internal operations but also adapt strategically to competitive pressures, ultimately fostering innovation and long-term sustainability.

Ethics Declaration

Ethical clearance was obtained from the University of Johannesburg's, College of Business and Economics (CBE) Research Ethics Committee. Ethics clearance for this research was approved on 10 August 2022. Reference number: 2022SCiiS038.

AI Declaration

The authors declare that the Artificial Intelligence (AI) tool, ChatGPT by OpenAI, was used. The AI assistance was limited to idea organisation and all intellectual content, critical analysis, and final interpretations were conducted by the authors. The use of AI tools complied with ethical standards and authorship criteria.

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Student's Perceptions Towards Blackboard and Moodle as Tools for Innovative and Self-directed Learning

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Abstract: A Learning Management System (LMS) contributes highly to the learning experience of university students. A Learning Management System plays a fundamental role in modern education by providing a well-organised platform for managing, delivering, and tracking learning activities. The importance of Learning Management Systems has grown significantly, as educational institutions and organisations progressively lean towards digital learning environments to promote innovative learning. Learning Management Systems such as Blackboard and Moodle can offer a flexible platform for students to foster self-directed learning, collaboration and digital competency. However, it is imperative to gain student buy-in as the success of a platform such as Blackboard or Moodle depends on student acceptance and engagement. The purpose of this study was to determine the perceptions of university students towards two different Learning Management Systems, namely Blackboard and Moodle, as tools for innovative learning and self-directed learning. The sample for this study was made up of 196 third-year students who had experience working with both Blackboard and Moodle. Online questionnaires were sent out to the identified third-year students and responses were then analysed using both data visualisation and descriptive analysis. The results yielded from the study gave a clear guideline of the perceptions that students had towards Blackboard and Moodle as tools for innovative learning and self-directed learning. The findings of this study strongly indicate that Blackboard was perceived by students as a more effective platform for supporting innovative and self-directed learning compared to Moodle. Blackboard's structured layout, intuitive navigation, and features such as progress tracking, announcements, and virtual classrooms were frequently cited as factors that enhanced students' ability to manage their learning independently and engage creatively with course material.

Keywords: Learning Management System, Innovative Learning, Self-directed Learning, Moodle, Blackboard, Student Perceptions

1. Introduction

"In today's rapidly changing world, the most important skill a student can learn is how to learn. Self-directed and innovative learners will be best prepared to adapt, thrive, and lead" (Wagner, 2012). Learning is not only the product of formal face to face class sessions that students receive from educators. Learning is also the product of student engagement with content, driven by curiosity, creativity, and the ability to take ownership of one's own learning process. According to Simelane-Mnisi (2023), in a bid to promote innovative learning and self-directed learning, educational institutions have supplemented face to face learning with digital tools such as learning management systems (LMS).

This study offers a novel contribution to existing literature by exploring and comparing university students' perceptions of both Blackboard and Moodle as tools for fostering innovative and self-directed learning. While previous research has explored the role of LMS in education, a comparative analysis of student perceptions across these two prominent learning management systems in the context of innovation and self-direction remains underexplored. Therefore, the purpose of this study was to determine the perceptions of university students towards Blackboard and Moodle as tools for innovative and self-directed learning.

2. Literature Review

The focus of this research as stated in the introduction is to determine the perceptions of university students towards Blackboard and Moodle as tools for innovative and self-directed learning. To set the tone for this study it is imperative to briefly unpack the key concepts namely, LMS, innovative learning and self-directed learning. A learning management system is a software application that is designed to manage, deliver and track online courses such as, educational courses, training programs and learning and development initiatives (Emmamoge, Hassan & Kauthar, 2020, cited in Gamede et al., 2021). Innovative learning is student centred; it promotes critical thinking amongst students, it fosters creativity, it looks at addressing real-world problems and it leverages technology in order to provide students with learning material and platforms that will allow for engagement (Mogashoa & Mkhize, 2023). Self-directed learning is characterised by an individual taking ownership of their learning process without relying soley on their educator to navigate them through their academic journey (Lai, Saab & Admiraal, 2022). The comparative nature of this research also required that a summary of the features offered by both Learning Management Systems, namely Blackboard and Moodle, were to be included in the

study. Providing a summary of the features contributed to contextualising the student feedback regarding the specific tools available to them, specifically those tools that they felt contributed to innovative and self-directed learning. Table 1 and Table 2 provide an overview of the key features offered by both Blackboard and Moodle.

Table 1: Features of Moodle (Moodle, 2025)

Features	Description
General Features	
Modern easy to use interface	Moodle offers a modern interface which is easy to navigate, on both desktop and mobile devices.
Personalised My course page	Moodle has a course page which displays current, past and future courses.
See-at-a-glance timeline	Moodle has a dashboard which allows for users to view all deadlines and calendar events simultaneously.
Collaborative tools and activities	Moodle offers users many activities such as forums, wikis, glossaries, and other activities to foster collaboration.
Convenient file management	Moodle allows for files to be uploaded into the Moodle environment from various locations such as cloud storage services including MS OneDrive, Dropbox and Google Drive.
Notifications	When enabled, Moodle allows for users to receive automatic alerts on new assignments and deadlines, forum posts and also send private messages to one another.
Tracking Progress	Educators and learners can track progress with an array of features for tracking individual activities, such as gradebook. Features such as detailed reporting and analytics are also available for educators to track student progress.
Continuous Improvement	As an open-source project, it benefits from ongoing development and improvements from a global community.
Cost-Effective	Due to its open-source nature, Moodle is generally less expensive to use than commercial LMS platforms.
Administrative Features	
Customisable site Design and Layout	Moodle offers options for customizing themes, logos, and layouts or for designing one's own theme.
Secure authentication and mass enrolment	Moodle offers various ways to manage authentication through authentication plugins. Moodle also offers various options to add and enrol users to your Moodle site and courses through enrolment plugins.
Multilingual Capability	Moodle allows users to view course content and learn in their own language or set it up for multilingual users and organisations.
Bulk course creation and easy backup	Moodle allows for courses to be added in bulk, for courses to be backed up and large courses to be restored with ease.
Manage user roles and permissions	Moodle allows for managing and assigning roles to various stakeholders based on the role that they are required to fulfil within a specific module.
Open Standards	Moodle supports open standards like IMS-LTI and SCORM.
Regular security updates	Moodle is regularly updated with the latest security patches to help ensure your Moodle site is secure.
Course Development and Management Features	
Direct learning path	Moodle allows for courses to be design and managed to meet various requirements. Classes can be instructor-led, self-paced, blended or entirely online.
Encourages collaboration	Moodle has built-in collaborative publishing features that foster engagement and encourage content-driven collaboration.
Multimedia integration	Moodle's built-in media support enables you to easily search for and insert video and audio files in your courses.
Group management	The group feature on Moodle allows educators to learners to share courses, differentiate activities and facilitate teamwork.
Marking work flow	Moodle allows for markers to be Conveniently assigned to different assignments, manage grade moderation and control when marks are released to individual learners.
In line marking	Moodle allows for a marker to easily review and provide in-line feedback by annotating files directly within browser.

Features	Description
Peer and self-assessments	Moodle has built-in activities such as workshops and surveys to encourage learners to view, grade and assess their own and other course members' work as a group.
Integrated badges	Fully has badges compatible with Mozilla Open Badges, motivate learners and reward participation and achievement with customised Badges.
Advanced grading	Moodle allows educators to select from advanced grading methods to tailor the gradebook to their course and examination criteria.
Competency based marking	Moodle allows for educators to set up competencies with personal learning plans across courses and activities.
Security and privacy	Moodle has strong security measures throughout the platform. Moodle also allows educators to teach and share in a private space only you and your class can access.

Table 2: Blackboard features (Aidoos, 2024; Blackboard Inc., 2024)

Features	Description
General Features	
Mobile access	Blackboard allows for students to access course materials via the Blackboard mobile app.
User dashboard	Blackboard has a dashboard which displays all the past, current, and future courses that a student is enrolled in. The dashboard also displays the achievements that a student has earned and the progress that a student is making in courses where the progress tool is enabled by the lecturer.
Notifications	Blackboard allows for real-time updates on assignments, grades, and messages.
Accessibility support	Blackboard is invested in the usability and accessibility of all its products and services, therefore it endeavours to design and develop its products and services aligned with internationally recognized Web Content Accessibility Guidelines (WCAG), as well as Section 508 of the Rehabilitation Act of 1973.
Cloud integration	The Blackboard Partner Cloud streamlines its inventory of content into a single registration and activation process.
Administrative Features	
Course creation and management	Blackboard allows individuals with admins rights to create, copy, archive, and delete courses.
User enrolment and roles	Blackboard allows for various roles (Instructor, Student, Teaching Assistant) to be assigned to different individuals enrolled for a module.
Course catalogue management	Blackboard allows for institutions to create, manage and organize courses into searchable categories.
Permissions and access control	Blackboard has access control which is an essential security measure that regulates user access to resources, ensuring that only authorised individuals can perform specific actions or access certain data.
System reporting and analytics	Blackboard allows instructors and teaching assistants to monitor student activity, content access and overall performance.
Tool management	Enable or disable features/tools at institution or course level.
LMS integration	Integrates with SIS, LTI tools, and authentication systems.
Course Development and Management Features	
Content authoring tools	Blackboard allows for instructors to create and organise modules, multimedia, and learning units according to their needs.
Course templates	Blackboard allows instructors to reuse and customise course structures and content across terms or sections.
Course copy and export	Course Copy and Export is a feature in Blackboard which allows instructors to copy entire courses or export them for sharing or backup.

Features	Description
Assessment and quizzes	Blackboard allows for instructors to design tests with multiple question types, such as multiple-choice questions, multiple answer questions, true/false questions and essay type questions. Automated grading is also a feature available in Blackboard.
Test pools and question banks	In Blackboard tests do not always have to be started from scratch as instructors can reuse and randomize assessment content across courses.
Self and peer assessment	Blackboard provides students with the opportunity assess themselves and to evaluate each other's work using predefined criteria.
Grade centre	The grade centre in Blackboard serves as a snapshot of all the students marks. The grade centre allows for flexible grading with weighting, calculated columns, and rubrics.
Assignments and drop box	Create assignments with file submission, plagiarism check (SafeAssign).
Communication tools	Blackboard uses announcements, emails, and messages to engage students.
Discussion boards	Blackboard enable peer-to-peer interaction through asynchronous discussions.
Blogs and journals	Blackboard has blogs and Journals which allow students to partake in reflective writing.
Feedback and rubrics	Blackboard provides timely, detailed feedback of assessments with standardized rubrics.
Learning modules	Blackboard allows for instructors to organise content into sequenced, trackable modules for structured learning.
Adaptive release	Blackboard allows for content to be released on pre-defined criteria such as releasing a test on specific date to specific students based on their student numbers.
Multimedia & SCORM support	Blackboard supports embedding multimedia content like videos and animations, as well as SCORM packages, directly into courses.
Collaborate ultra (Virtual Classroom)	Blackboard ultra allows for live sessions through virtual classroom. meetings.

3. Research Design and Methodology

A carefully selected research design and methodology is essential to the success of any research study. The research design and methodology of a study serves as the blueprint which dictates how a study is conducted. All the necessary techniques or procedures used to collect, analyse and interpret data are selected in the research and methodology phase. Based on Saunders, Lewis and Thornhill's (2019: 108) research onion (see fig 1), the following research design and methodological choices were made for this study:

- **Philosophical paradigm:** For this study, pragmatism served as the philosophical paradigm of choice. Pragmatism focuses on the practical outcomes of ideas, and on solving real world problems. The focus of this study was on determining the perceptions of third-year students towards Blackboard and Moodle as tools for innovative and self-directed learning therefore, it aligns with the ethos of pragmatism which delves into practical utility and effectiveness.
- **Theoretical underpinning:** Constructivism and self-determination were the two theories that underpinned this study. Constructivism states that learners actively construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences. In the context of digital tools, this implies that the design and functionality of Blackboard and Moodle could either facilitate or hinder students' active engagement and knowledge construction, thereby impacting their innovative learning. Self-determination theory, particularly its emphasis on autonomy, provided a lens through which to understand self-directed learning. If students perceived Blackboard and Moodle as supporting their autonomy as learners, they would more likely engage in self-directed learning.
- **Methodological choice:** This study used a mono-method approach, in the form of an online questionnaire which contained both open-ended and closed-ended questions. The addition of both open-ended and closed-ended questions allowed for better insight into addressing the purpose of the study.

- **Time Horizon:** This study took on a cross-sectional time horizon as data was collected from third-year students on one occasion. Essentially the study provided a snapshot of the perceptions of third-year students in 2024.
- **Data collection and analysis:** Data was collected with an online questionnaire which was compiled using Google forms. The questionnaire contained both open-ended and closed-ended questions that were analysed using data visualisation and descriptive analysis.
- **Sample:** Purposive sampling was used to select the sample for this study, which comprised 196 third-year students enrolled in the School of Consumer Intelligence and Information Systems at the University of Johannesburg. This specific sample was selected due to their relevant experience with both Learning Management Systems. All participants possessed two to three years of experience with Blackboard and one year experience with Moodle, providing a good basis for comparative perceptions.
- **Validity and reliability:** To enhance the validity and reliability of the questionnaire, a pilot test was conducted with an individual who possessed extensive knowledge on teaching and learning within the LMS domain. The valuable feedback received from this individual was then integrated to refine the final questionnaire.

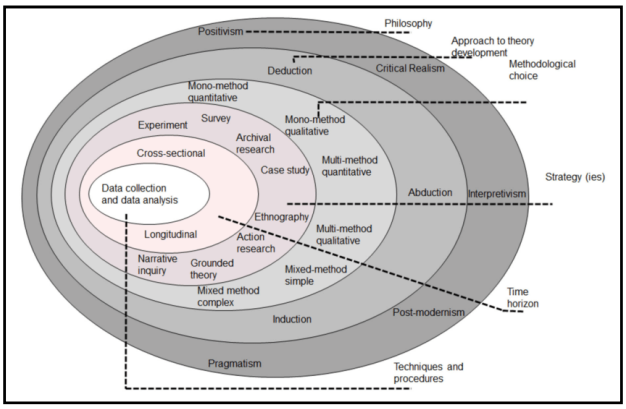


Figure 1: Research onion (Saunders et al., 2019, p. 108)

4. Results and Discussion

Following the distribution of online questionnaires, via Google Forms to the third-year students who formed part of the sample, the closed-ended and open-ended responses were subsequently analysed and interpreted as outlined below."

4.1 Presentation and Interpretation of Closed-ended Questions

Figure 2 - 10 serve as a visual representation of the responses received from the closed-ended questions that were disseminated to the students. Of the 196 students who responded to the questionnaire 91.7% stated that they used to accessed Blackboard on a daily basis to access their course work. Of the 196 only 8.3% said that they used to access Blackboard once a week. In terms of Moodle a 100% of the students stated that they currently accessed Moodle daily (See figure 2 and 3). These findings reflect self-regulation and initiative from the student's side, and a willingness to access the learning management systems that are offered by their institution. Students who regularly access their institution's LMS demonstrate key attributes of self-directed and innovative learners.

In terms of the overall learning experience (See figure 4), and the overall collaboration experience (See figure 5), Blackboard dominated with 76.5% stating that Blackboard offered a better learning experience than Moodle. The students also felt that Blackboard offered a better overall collaboration experience. However, there were 5.9% of the students who did feel that Moodle was slightly better than Blackboard in terms of collaboration. The following statement was then posed to students (See figure 6) "***Moodle provides a more innovative and engaging learning experience compared to Blackboard. (e.g. forums, online engagement, Lecturer to student engagement, student to student engagement)".*** Based on this statement 52.9% and a further 23.5% strongly disagreed with the statement clearly leaving the impression that Blackboard was perceived, by the students, to be a better LMS for innovative and engaging learning.

The students were also asked to rate the following statement (See figure 7) ***"I prefer Moodle over Blackboard for innovative learning".*** The responses yielded from this statement showed that 41.2% of the students strongly disagreed while 23.5% disagreed. These percentages left the impression that again, Blackboard was the clear preference for innovative learning. In both the above statements there were students who were unsure, and this could perhaps be attributed to the fact that students had more working experience with Blackboard. In both above-mentioned statements there was a percentage of students, albeit small, that agreed to Moodle being the better choice for innovative and engaging learning.

In terms of the user friendliness of Blackboard and Moodle (See figure 8), which encompass aspects such as easy navigation, personalised learning and engaging content and activities for students, a significant 82.4% of the students felt that Blackboard was much easier to use. Lastly students were asked if they thought if Blackboard was used effectively by their lecturers as a tool for innovative learning and if Moodle is currently being used effectively by lecturers for innovative learning. A 100% of the students agreed that Blackboard was indeed used effectively for innovative learning, however with regards to Moodle 75% disagreed and only 25% agreed. Based on the closed-ended questions and the responses thereof it can be concluded that Blackboard was the preferred LMS in terms of innovative learning. The responses provided may also suggest that lecturers may need to consider engaging more with the features in Moodle, that support innovative learning and evoke self-directed learning.

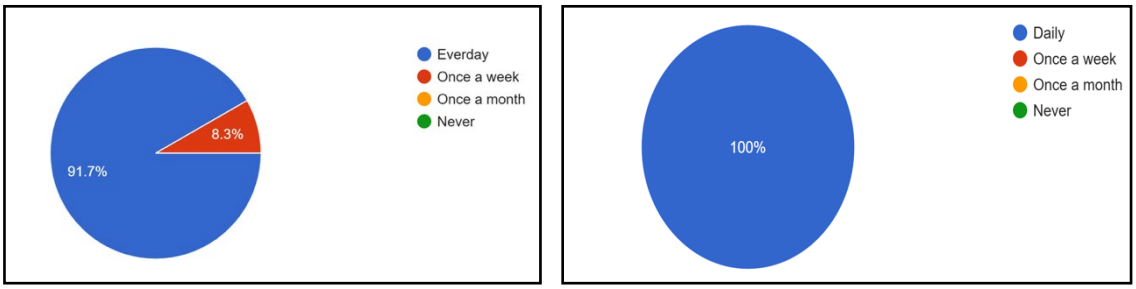


Figure 2 and 3: Blackboard vs Moodle access (own source developed for this study, 2024)

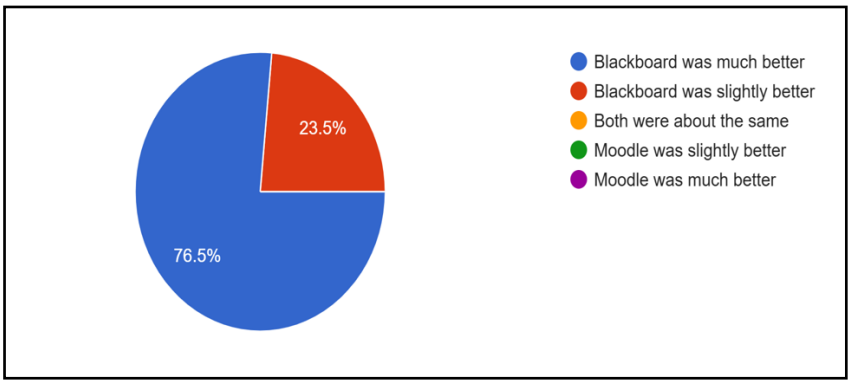


Figure 4: Overall learning experience (own source developed for this study, 2024)

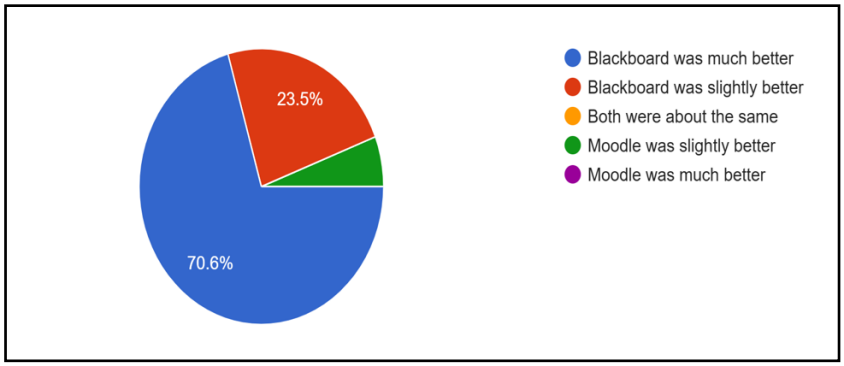


Figure 5: Overall collaboration experience (own source developed for this study, 2024)

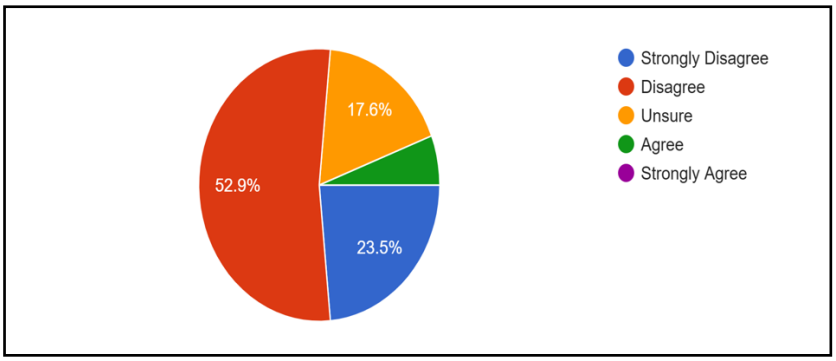


Figure 6: Innovative and engaging learning experience: Moodle vs Blackboard (own source developed for this study, 2024)

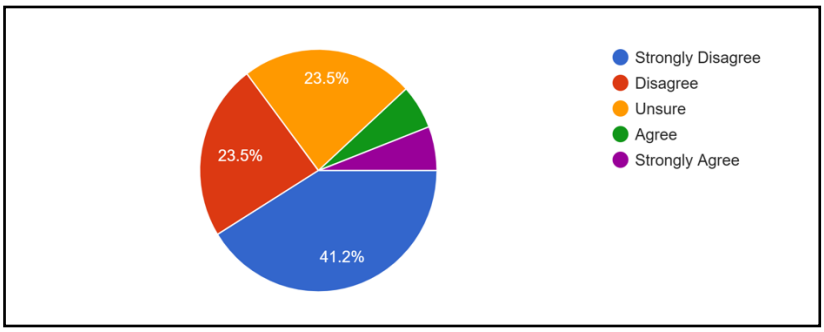


Figure 7: Moodle over Blackboard for innovative learning (own source developed for this study, 2024)

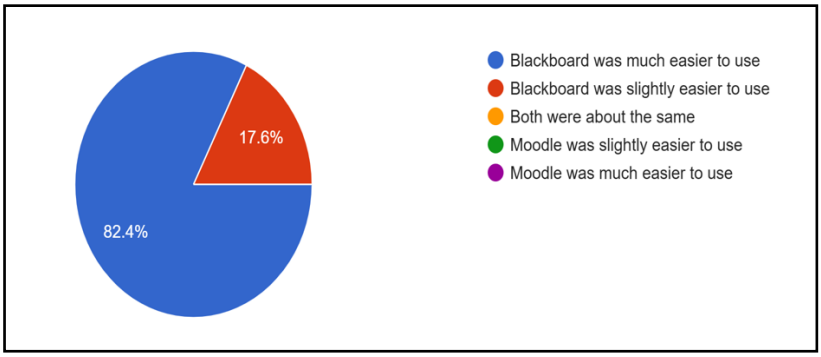


Figure 8: User Friendliness of Blackboard and Moodle (own source developed for this study, 2024)

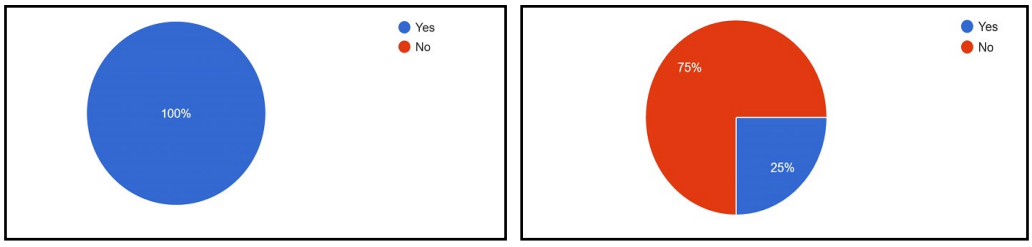


Figure 9 and 10: Use of Blackboard vs Moodle for innovative learning (own source developed for this study, 2024)

4.2 Presentation and Interpretation of Open-ended Questions

Based on the responses from the open-ended questions student perceptions highlighted Blackboard's navigation and user-friendliness, as contributing factors to a significantly better learning experience. Key features that were praised on Blackboard included its well-organised course modules, intuitive interface, and effective announcement/notification systems. Students also valued the virtual class tools and progress-tracking

features, which actively promoted self-directed learning. Verbatim responses emphasized Blackboard's "clearly organised course modules," "intuitive interface," and its ability to help students "manage deadlines and monitor their learning milestones effectively."

In contrast, Moodle faced consistent criticism regarding its user interface and navigation. Students described Moodle as "overcomplicating basic functions" and having a "cluttered and unwelcoming" interface, which made it difficult to access content efficiently. While many students reported no significant challenges with Blackboard, occasional issues like downtime or streaming difficulties were noted. Moodle, however, was frequently cited for poor organisation and technical glitches like continuous logouts.

Ultimately, Blackboard emerged as the preferred platform for both collaborative and self-directed learning. Students praised Blackboard's integrated collaborative tools, which fostered a cohesive environment for group projects and discussions. For self-directed learning, Blackboard's organised structure and intuitive navigation were highlighted as crucial for managing coursework, tracking progress, and exploring subjects independently. These findings were consistent across open-ended and closed-ended responses, firmly establishing Blackboard as the favoured LMS for supporting innovative and self-directed learning.

5. Conclusion

The main objective of this study was to explore the perceptions of third-year university students towards the utilisation of Blackboard and Moodle as tools for innovative and self-directed learning. Keeping into consideration the evolving educational landscape in terms of technology, this study endeavoured to understand which Learning Management System better facilitates learner independence, engagement and knowledge construction. The findings of this study strongly indicate that Blackboard was perceived by students as a more effective platform for supporting innovative and self-directed learning compared to Moodle. Blackboard's structured layout, intuitive navigation, and features such as progress tracking, announcements, and virtual classrooms were frequently cited as factors that enhanced students' ability to manage their learning independently and engage creatively with course material. Conversely, students reported that Moodle posed challenges related to interface complexity, content organization, and limited support for media integration and collaborative tools. Despite Moodle's potential and open-source flexibility, students in this context did not perceive it as being used effectively to support innovation or self-direction. This highlights the importance of not only platform capability but also institutional implementation and lecturer engagement in optimising LMS use. It is recommended that institutions who are considering or who are currently using Moodle, to prioritize user experience in digital learning environments by adopting a student-centric approach in platform implementation, ensuring intuitive design to facilitate learner independence. It is also recommended that institutions acknowledge and address prior user experience when adopting or evaluating new LMS platforms, implementing comprehensive scaffolding and support to mitigate familiarity bias and ensure equitable learning opportunities across different systems. It is important to note that the students who formed part of the sample for this study had more working experience with Blackboard hence this could have contributed to them perceiving Blackboard as a better LMS for innovative learning and self-directed learning.

Ethics Declaration

Ethical clearance was obtained from the University of Johannesburg's, College of Business and Economics (CBE) Research Ethics Committee. Ethics clearance for this research was approved on 15 November 2022. Reference number: 2022SCiiS043.

AI Declaration

The authors declare that the Artificial Intelligence (AI) tool, Gemini, was used. The AI assistance was limited to idea organisation and all intellectual content, critical analysis, and final interpretations were conducted by the authors. The use of AI tools complied with ethical standards and authorship criteria.

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Operationalizing Digital Transformation: A Capability-Based Maturity Model

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Abstract: Digital transformation (DT) has become a strategic imperative for organizations navigating an era of rapid technological advancements. It deeply requires the development of capabilities that enable firms to continuously sense, seize, and reconfigure resources to sustain competitive advantage. However, despite this need, existing maturity models primarily focus on technological dimensions, often overlooking the organizational capabilities required for a systematic and effective transformation. This study addresses this shortcoming by proposing a capability-based maturity model that extends the Digital Transformation Dynamic Capability framework developed by Leso et al. (2023), operationalizing its thematic areas (designing and managing transformation, fostering digital value propositions, engaging in digital business ecosystems, systematizing structural changes, and leveraging enablers) into a structured assessment tool. By integrating dynamic capabilities theory with a maturity perspective, this model provides a comprehensive framework to evaluate an organization's ability to undergo and sustain DT. To test the model, we conducted expert content validation and empirical testing with 43 Italian companies embedded in a digital innovation ecosystem. The results indicate that while organizations exhibit moderate to high maturity in areas such as digital innovation management and technological infrastructure, they face challenges in transformation planning and business model adaptation. These findings underscore the necessity of a strategic and capability-oriented approach to digital maturity, moving beyond a purely technological focus. By providing an actionable framework, this research equips organizations with a strategic roadmap to enhance their digital capabilities, ensuring adaptability in an increasingly complex and evolving digital landscape

Keywords: Digital Transformation, Capability Maturity Model, Dynamic Capabilities, Organizational Adaptability

1. Introduction

Technological change disrupts industries and creates new business models in today's dynamic digital economy. Digital transformation (DT) is widely recognised as a critical factor for sustaining organisational competitiveness amid accelerating technological advancements and evolving consumer expectations (Verhoef et al., 2021). However, beyond its technological dimension, DT requires strategic renewal and organisational adaptability, involving changes in processes, structures, cultural paradigms, and mobilization of intangible assets (Gong and Ribiere, 2020; Warner and Wäger, 2019; Bharadwaj 2000).

Despite its strategic importance, organisations face considerable challenges when implementing DT initiatives, such as resistance to adoption, lack of digital skills among employees, and difficulties in aligning digital strategies with a rapidly evolving market (Chirumalla, 2021; Leso et al., 2022; Vasconcellos et al., 2022). Moreover, the complexity of DT calls for higher-order capabilities that support continuous adaptation in dynamic and uncertain environments. In this context, the dynamic capabilities (DC) perspective presents a valuable lens through which to understand the capabilities required for DT at the firm level (Teece, 2007; Vial, 2019). However, existing research suggests that such capabilities remain underexplored, particularly regarding how organisations can develop and operationalise them (Leso et al., 2023).

To address these challenges, maturity models have been widely used to assess progress, identify gaps, and prioritise strategic actions in DT (De Bruin et al., 2005). However, many of the DT models focus heavily on technological dimensions or are constrained to specific sectors, lacking the flexibility to address the broader

organisational implications of DT (Lin et al., 2020). This study advances the field by proposing a capability-oriented approach grounded in the Digital Transformation Dynamic Capability (DTDC) framework (Leso et al., 2023). The DTDC integrates a maturity-based assessment with the DC lens, identifying five thematic areas encapsulating microfoundations of sensing, seizing, and reconfiguring capabilities (see Table 1). It provides a structured yet adaptable foundation for understanding and managing DT at the organisational level.

Influenced by prior studies (e.g., Schumacher et al., 2019; North et al., 2020), the present research operationalises the DTDC into a robust and practical assessment tool designed for empirical application. This instrument aims to support strategic planning and capability development by offering organisations actionable and capability-oriented insights that bridge diagnostic evaluation and transformation strategy, beyond the limitations of technology or sector-specific models.

The proposed model was empirically tested in 43 Italian companies operating within a digital innovation ecosystem, demonstrating its relevance and applicability across varied organisational environments. This work contributes to both theory and practice by advancing the understanding of DC in DT and offering a validated instrument for capability assessment. It underscores the value of a structured yet adaptable approach to managing transformation, enabling organisations to align cultural, structural, and strategic elements with the demands of the digital age.

2. Digital Maturity Model

DT represents a significant organizational challenge, requiring continuous and systematic analysis of a company's positioning relative to digital competencies and resources. However, traditional approaches often fail to capture the complexity of this evolution, highlighting the need for sophisticated maturity models capable of continuously measuring and improving digital capabilities. In this sense, present research addresses this challenge by developing and testing a comprehensive digital maturity model through an iterative process based on the design research approach (Hevner et al. 2004). This methodology facilitated the creation of a flexible instrument capable of capturing the dynamic evolution of organizational capabilities in response to digital demands.

Starting from the DTDC framework configuration, the maturity model is strategically structured around five thematic action areas and employs DTDC's microfoundation patterns as core dimensional indicators. Through incremental maturity level assessments, it captures the complex, dynamic nature of organizational digital evolution, operationalizing dimensions into 23 evaluation items based on microfoundations representing the organizational capabilities (Table 1).

After the model was refined through an iterative development process that ensures methodological rigor, systematic development of assessment instruments, and validation against empirical observations. Unlike simplistic linear models, this approach acknowledges the intricate and evolving nature of digital capabilities in contemporary organizations. The research integrates theoretical depth with practical applicability, offering a sophisticated instrument for understanding and navigating digital transformation. Furthermore, five general maturity levels were established, inspired by Schumacher et al. (2019) (Table 1): Level 0 indicates the organization does not have any initiative in the matter; Level 1 is characterized by planning efforts, with some familiarity and reactive initiatives; Level 2 shows understanding of the subject's importance, and some proactive (yet irregular) activities occur without defined standards or relying on specific individuals; Level 3 includes recurring initiatives with noticeable contributions to company results, though still lacking full process structuring; and Level 4 indicates a proactive, structured process with systematic recurrence and defined responsibilities, validated and integrated into organizational results.

An assessment instrument was then proposed. To this end, a questionnaire was developed whereby each item reflected one of the previously identified patterns. To ensure respondents considered the underlying categories, the description of each question included details of its component categories. To improve response agility, the personalized maturity levels were replaced with a general description of the levels and applied uniformly. Figure 1 illustrates the final version of a question.

2.1 Data Collection

The instrument was tested with organisations within the Politecnico di Milano innovation ecosystem, specifically those associated with the Digital Innovation Observatory. This initiative is a central hub for digital innovation in Italy, combining research, communication, and continuous monitoring of technological trends. From a pool of 484 companies, the sample was narrowed based on an inclusion criterion: firms needed to exhibit a minimum

level of digital maturity, defined according to Verhoef et al. (2021), to ensure alignment with strategic use and management of digital resources.

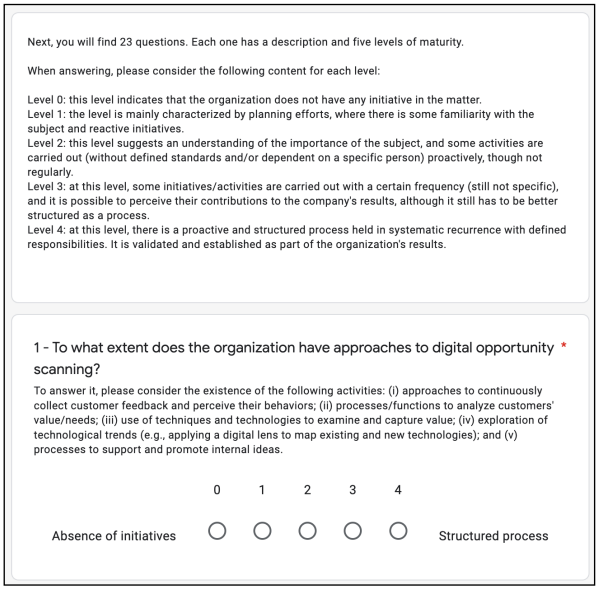
Table 1: Dimensions and evaluation items

Area	Dimensions (*Pattern*)	Items
Fostering digital value propositions	Digital opportunity scanning	Continuous collection of customer feedback and evidence; Analysis of customers' value/needs; Exploration and analysis of data; Exploration of technological trends; Internal sensing
	Digital opportunity evaluation	Analysis and refinement of digital opportunities; Digital assertiveness; Financial analysis of digital opportunities; Regular meetings for opportunity analysis and alignment
	Digital innovation management	Fostering digital innovation; Development of MVP and tests; Usage of a digital innovation lab; Development/improvement of digital solutions; Development of individualized and segmented solutions; Development of hybridized solutions (digital + physical)
	Business Model reconfiguration / digitalization	Data acquisition; Data storage in the cloud; Process and operation automation/digitalization; Smart and autonomous processes
Designing and managing transformation	Transformation planning	Analysis of challenges and risks; Analysis of growth possibilities; Comprehension of digital transformation; Definition of the transformation strategy; Development of an implementation roadmap; Establishing objectives and metrics
	Transformation management	Follow-up and review/adjustment of the transformation strategy; Management of performance capacity; Pacing the transformation; Data-driven decision
	Transformation promotion	Continuous follow-up alignment; Employees involvement; Market communication
	Knowledge and Learning Management	Data management; IT Security; Knowledge management
Acting in digital business ecosystems	External exploration	Competition monitoring; Interactions with ecosystem players; Partnership searching
	Ecosystem exploitation	Exploitation of the ecosystem capabilities; Integration of processes/systems with partners; Management of the ecosystem
	Significant collaborations and partnership	Establishment of collaboration and open innovation; Incorporation/incubation of digital businesses
Systematizing structural changes	Agile practices orientation	Exploration of agile practices in digital business management; Exploration of agile practices in tech projects
	Multidisciplinary teams and flexibility	Promotion of flexibility and autonomy in work; Support multidisciplinary teams
	Employee structure modification	Incorporation of new roles and functions; Redefinition of roles and positions; Offboarding of people misaligned with the company's purpose
	Knowledge and competence improvement	Leveraging digital and product/service design competence; Recruitment of/access to digital knowledge; Recruitment of/access to product and design competence; Recruitment of/access to strategic knowledge
	Organizational structure redesign	Change of the organizational structure; Systematic structure reviews
Supporters and enablers of a DTDC	Financial resources	Financial resources
	Human capital	Digital competence; Interpersonal skills; Technical skills
	Leadership competence and attitude	Leadership competence; Top management and leadership informed and updated; Top management and leadership presence and support
	Organizational culture	Digital and entrepreneurial awareness

Area	Dimensions (*Pattern*)	Items
	Technological infrastructure	Data storage and processing; Hardware and devices; Information System
	Organizational management	Monitoring performance indicators; Organizational knowledge; Organizational management
	Process and operations mgmt	Data integration capability; Process and operation warranty; Process management

Source: Leso et al. (2023)

The questionnaire was administered in English between May and July 2022. It was designed to be completed anonymously by C-level executives or managers with sufficient knowledge of their firm's DT efforts.


Next, you will find 23 questions. Each one has a description and five levels of maturity.

When answering, please consider the following content for each level:

Level 0: this level indicates that the organization does not have any initiative in the matter.
Level 1: the level is mainly characterized by planning efforts, where there is some familiarity with the subject and reactive initiatives.
Level 2: this level suggests an understanding of the importance of the subject, and some activities are carried out (without defined standards and/or dependent on a specific person) proactively, though not regularly.
Level 3: at this level, some initiatives/activities are carried out with a certain frequency (still not specific), and it is possible to perceive their contributions to the company's results, although it still has to be better structured as a process.
Level 4: at this level, there is a proactive and structured process held in systematic recurrence with defined responsibilities. It is validated and established as part of the organization's results.

1 - To what extent does the organization have approaches to digital opportunity scanning? *

To answer it, please consider the existence of the following activities: (i) approaches to continuously collect customer feedback and perceive their behaviors; (ii) processes/functions to analyze customers' value/needs; (iii) use of techniques and technologies to examine and capture value; (iv) exploration of technological trends (e.g., applying a digital lens to map existing and new technologies); and (v) processes to support and promote internal ideas.

0 1 2 3 4

Absence of initiatives ○ ○ ○ ○ ○ Structured process

Figure 1: example of the data collection instrument. Source: elaborated by the author

2.2 Data Analysis

Data analysis was conducted using the Statistical Package for Social Sciences version 18. Organizations were segmented by size, and a descriptive analysis of the maturity of the 23 dimensions was performed. Additionally, the incidence of maturity levels across the 23 dimensions was analyzed, grouped by thematic area.

3. Results

A sample of 43 valid responses were obtained, representing 8.88% of the potential sample. According to Hill (1998), samples ranging from 10 to 30 are considered adequate for pilot studies, validating the sufficiency of the sample for analyzing results, even if not for statistical extrapolations or generalizations. The results were analyzed through segmentation based on two criteria: (i) company size (SMEs and large enterprises) and (ii) industry sector (service and product). In terms of company size, companies with 1 to 50 employees accounting for 39.5% of the respondents (n = 17). Medium-sized companies (51 to 250) constituted 25.6% (n = 11), while large companies (more than 250) comprised 34.9% of the sample (n = 15). The subsequent analyses consider only two size categories: SMEs (companies with up to 250 employees, 28 firms) and large enterprises (companies with more than 250 employees, 15 firms) (European Commission, 2003).

The pilot application yielded valuable insights into the levels of digital maturity achieved by the organizations. The most prominent areas included “Fostering Digital Value Propositions” and “Technological Infrastructure,” with high maturity levels in “Digital Innovation Management” (mean: 2.93). Conversely, areas related to “Ecosystem Exploitation” and “Employee Structure Modification” showed lower maturity levels in most companies, highlighting cultural and structural challenges.

Table 2: Organizations sector

Type	Sector	n (43)	%	Total
Service	Financial Services	7	16,28%	26
	IT & Services	6	13,95%	
	Health Care	5	11,63%	
	E-learning	3	6,98%	
	Food Services	2	4,65%	
	Logistics & Supply Chain	1	2,33%	
	Public Sector	1	2,33%	
	Publishing, Marketing & Entertainment	1	2,33%	
	Staffing & Recruiting	1	2,33%	
Product	Automotive Manufacturing	4	9,30%	16
	Semiconductor Manufacturing	4	9,30%	
	Fashion	3	6,98%	
	Industrial Manufacturing	3	6,98%	
	Made in Italy	1	2,33%	
	Packaging	1	2,33%	

3.1 Maturity Level of the Dimensions

Regarding the dimensions' standard deviation, no dimension achieved an average above maturity level 3 in the overall analysis. However, some dimensions approached level 3. For instance, "Digital Innovation Management" (mean: 2.930, SD: 1.033), "Digital Opportunity Scanning" (mean: 2.907, SD: 0.971), and "Technological Infrastructure" (mean: 2.907, SD: 1.109) were notably high. Conversely, no dimensions fell below level 2, although some were close to level 1, such as "Employee Structure Modification" (mean: 2.140, SD: 1.355), "Ecosystem Exploitation" (mean: 2.163, SD: 1.174), and "Transformation Management" (mean: 2.209, SD: 1.264).

Analyzing the segmented data, the positive highlights mirrored the general behavior. Dimensions linked to "Fostering Digital Value Propositions" remained near level 3. "Technological Infrastructure" was also significant, particularly in the large enterprises segment (mean: 3.2, SD: 1.014) and the product segment (mean: 3.053, SD: 1.026). In SMEs and the service sector, "Technological Infrastructure" averaged close to level 3 (mean: 2.750, SD: 1.143) but was surpassed by the "Organizational Culture" dimension (mean: 2.857, SD: 0.970).

Dimensions with lower maturity levels revealed patterns consistent with the overall average but with notable differences. For example, "Employee Structure Modification" showed level 1 in large companies (mean: 1.667, SD: 1.047) and was nearly unanimous as one of the lowest. However, in SMEs, while the dimension approached level 1 (mean: 2.393, SDD: 1.449), it was surpassed by "Agile Practices Orientation" (mean: 2.250, SD: 1.669), "Process and Operations Management" (mean: 2.286, SD: 1.213), and "Ecosystem Exploitation" (mean: 2.214, SD: 1.258).

3.2 Incidence of Maturity Levels According to Thematic Areas

Regarding the thematic areas, Tables 3 to 6 provide the distribution of companies across maturity levels for each dimension. In the "Fostering Digital Value Propositions" area (Table 3), more than 50% of companies reached maturity levels above 3 in all four dimensions. "Digital Innovation Management" stood out, with 34.15% of companies achieving level 4. Additionally, there was strong coherence across the dimensions "Digital Opportunity Scanning," "Digital Opportunity Evaluation," and "Digital Innovation Management," which predominantly reached level 3. Notably, large companies and service companies demonstrated a significant

incidence of level 4 in "Digital Innovation Management," while product companies exhibited consistent maturity at level 3.

Table 3: Fostering digital value propositions

Maturity Level	Digital op. Scanning	Digital op. Evaluation	Digital Innovation Mgmt	BM Reconfiguration/ Digitalization
General				
0	2,33%	0,00%	0,00%	0,00%
1	6,98%	18,60%	13,95%	9,30%
2	16,28%	18,60%	13,95%	**32,56%**
3	**46,51%**	**44,19%**	**37,21%**	**34,88%**
4	27,91%	18,60%	34,88%	23,26%
SMEs				
0	3,57%	0,00%	0,00%	0,00%
1	3,57%	10,71%	14,29%	7,14%
2	21,43%	25,00%	10,71%	**35,71%**
3	**39,29%**	**39,29%**	**42,86%**	35,71%
4	32,14%	25,00%	32,14%	21,43%
Large				
0	0,00%	0,00%	0,00%	0,00%
1	13,33%	33,33%	13,33%	13,33%
2	6,67%	6,67%	20,00%	26,67%
3	**60%**	**53,33%**	26,67%	**33,33%**
4	20,00%	6,67%	**40%**	26,67%

In general, it is possible to indicate that companies manifest proactive efforts to generate digital innovations - which is an expected result, taking into account the nature of the sample. Furthermore, it is noted that the Business Model reconfiguration/digitalization dimension presents a higher incidence at level 2 (in the overall result; and in SME and service segments) and low incidence at level 1, which may indicate a possible transition and consolidation phase of the capability.

In the "Designing and Managing Transformation" area (Table 4), not all dimensions exceeded 50% maturity at levels 3 or 4. For instance, "Transformation Management" had a significant portion of companies at level 1, influenced largely by SMEs (where level 1 accounted for one-third of the 27 companies). However, "Transformation Promotion" showed high maturity, particularly among service companies (33.33%). In general, one can say that there is a significant concern with the Transformation plan and development within organizations, but that the Change and knowledge management capabilities still need to gain more attention and maturity within SMEs.

Table 4: Designing and managing transformation

Maturity Level	Transf. Planning	Transf. Management	Transf. Promotion	Knowledge and Learning Management
General				
0	4,65%	9,30%	2,33%	6,98%
1	13,95%	25,58%	20,93%	13,95%

Maturity Level	Transf. Planning	Transf. Management	Transf. Promotion	Knowledge and Learning Management
2	23,26%	16,28%	18,60%	23,26%
3	**37,21%**	**32,56%**	**32,56%**	**30,23%**
4	20,93%	16,28%	25,58%	25,58%
SMEs				
0	3,57%	7,14%	0,00%	7,14%
1	17,86%	**32,14%**	21,43%	17,86%
2	21,43%	7,14%	21,43%	**25,00%**
3	**35,71%**	32,14%	**32,14%**	**25,00%**
4	21,43%	21,43%	25,00%	25,00%
Large				
0	6,67%	13,33%	6,67%	6,67%
1	6,67%	13,33%	20,00%	6,67%
2	26,67%	**33,33%**	13,33%	20,00%
3	**40,00%**	**33,33%**	**33,33%**	**40,00%**
4	20,00%	6,67%	26,67%	26,67%

The area of "Acting in digital business ecosystems" (Table 5) has one of the dimensions with the lowest average - Ecosystem exploitation, which is reflected in the incidence of responses regarding the maturity levels indicated by companies: 39.53% of companies indicated level 2.

Table 5: Acting in digital business ecosystems

Maturity Level	External Exploration	Ecosystem Exploitation	Significant Collaborations and Partnership
General			
0	9,30%	9,30%	6,98%
1	11,63%	16,28%	9,30%
2	30,23%	**39,53%**	**30,23%**
3	**32,56%**	18,60%	**30,23%**
4	16,28%	16,28%	23,26%
SMEs			
0	10,71%	10,71%	7,14%
1	14,29%	17,86%	10,71%
2	25,00%	**28,57%**	25,00%
3	**35,71%**	25,00%	**32,14%**
4	14,29%	17,86%	25,00%
Large			
0	6,67%	6,67%	6,67%
1	6,67%	13,33%	6,67%

Maturity Level	External Exploration	Ecosystem Exploitation	Significant Collaborations and Partnership
2	**40,00%**	**60,00%**	**40,00%**
3	26,67%	6,67%	26,67%
4	20,00%	13,33%	20,00%

Moreover, in this area, only the dimension Significant collaborations and partnership has more than 50% of the companies in levels 3 or 4; the other two dimensions are below this percentage, with almost 10% of the companies in level 0 (in which the vast majority are SMEs).

In relation to the dimension of "Significant collaborations and partnership", a strong maturity in the capacity of companies in the service sector to develop partnerships can be perceived. This trend is not followed by the product companies, in which this dimension is more mature at level 2. Based on these results, it is possible to indicate that there is a growing maturity in the capacity for external recognition, although there is a maturity to be conquered for greater use of the capabilities that exist within the ecosystem.

The results of the "Systematizing structural changes" area (Table 6) show a more significant variation and diffusion than the previous areas, evidencing that the ability to deal with the necessary changes of DT still needs to be better established within the spectrum of organizations. This area, for example, has three dimensions in which more than 50% of the companies indicated levels 3 or 4 of maturity: Agile practices orientation, Multidisciplinary teams and flexibility, and Knowledge and competence improvement. However, about the first dimension, it is important to note that its general average (2.256), previously presented, is strongly influenced by the rate of companies that do not possess this capability (present level 0), 20.93%. This dimension was the one that received the most level 0 responses among all 23 dimensions, but, at the same time, it presents a strong incidence in levels 3 and 4 in general and in the segments (although no large company indicated level 4). This contrasting scenario may indicate difficulty in adopting agile approaches or translating the pillars of agility.

In addition, the Employee structure modification dimension, which has the lowest overall average (2.140), has the incidence of dispersed maturity levels, with more conciseness in level 2 and more than 30% of the companies in level 0 or 1. Finally, we point out that the Knowledge and competence improvement dimension represents a capability that receives attention from the companies that responded to the survey, showing interesting results in the segments, with large companies or companies from the product sector showing greater maturity than in the SMEs and service companies.

Table 6: Systematizing structural changes

Maturity Level	Agile Practices Orientation	Multidisciplinary Teams and Flexibility	Employee Structure Modification	Knowledge and Competence Improvement	Organizational Structure Redesign
General					
0	20,93%	2,33%	13,95%	4,65%	6,98%
1	11,63%	18,60%	18,60%	13,95%	18,60%
2	11,63%	16,28%	**30,23%**	25,58%	25,58%
3	**32,56%**	25,58%	13,95%	**37,21%**	**32,56%**
4	23,26%	**37,21%**	23,26%	18,60%	16,28%
SMEs					
0	25,00%	0,00%	14,29%	7,14%	7,14%
1	14,29%	21,43%	14,29%	10,71%	17,86%
2	7,14%	21,43%	21,43%	25,00%	17,86%
3	17,86%	10,71%	17,86%	**32,14%**	**39,29%**
4	**35,71%**	**46,43%**	**32,14%**	25,00%	17,86%

Maturity Level	Agile Practices Orientation	Multidisciplinary Teams and Flexibility	Employee Structure Modification	Knowledge and Competence Improvement	Organizational Structure Redesign
Large					
0	13,33%	6,67%	13,33%	0,00%	6,67%
1	6,67%	13,33%	26,67%	20,00%	20,00%
2	20,00%	6,67%	**46,67%**	26,67%	**40,00%**
3	**60,00%**	**53,33%**	6,67%	**46,67%**	20,00%
4	0,00%	20,00%	6,67%	6,67%	13,33%

Regarding the area of "Supporters and enablers of a DTDC", more than 50% of the companies present maturity above level 3 in all its dimensions. This result highlights the maturity of the companies connected to the Observatory and, thus, evidences the positive and significant relationship between these dimensions and the ability to innovate digitally. In this context, the Technological infrastructure dimension stands out, whose overall average is 2.907, and almost 40% of the companies indicate maturity level 4, ratifying this dimension's significant role as an enabler in companies that promote digital innovations. Furthermore, it can be seen that the maturity level of leadership in the companies, through the Leadership competence and attitude dimension, is also expressive, with 32.56% of the companies indicating a maturity level 4. This is a significant result, as it helps to confirm recent scientific production results regarding leadership posture in a digital transformation context, such as He et al. (2022) and AlNuaimi et al. (2022).

4. Discussion

Leso et al. (2023) found that existing models fail to address a maturity perspective based on companies' ability to continuously adapt their business models to remain relevant in a dynamic and ever-changing digital context. Furthermore, previous efforts to capture the capabilities required for organizational change (e.g., Warner and Wäger, 2019; Soluk and Kammerlander, 2021) often lack depth regarding the practical application of their compelling findings. At the intersection of these two gaps lies the importance of operationalizing the DTDC framework into a tangible maturity model, offering organizations a holistic tool to assess and scale their digital maturity levels. Based on the results obtained, two key areas of discussion emerge: (i) the development and test of the model as a capability-based instrument for assessing organizational maturity and (ii) its theoretical and practical implications.

First, the results, collected within a controlled scope targeting organisations affiliated with a digital innovation observatory and meeting inclusion criteria based on Verhoef et al. (2021), enabled the testing of the instrument against expected outcomes, thereby supporting its validity and contextual alignment with digitally engaged organisations. For instance, the presence of moderate to advanced maturity levels in dimensions such as "Digital Innovation Management" was anticipated and observed, reinforcing the model's empirical coherence

The pilot study's controlled scope also facilitated identifying opportunities for future applications. Theoretically, the model advances the maturity model literature by enabling the assessment of DT through a capability-based lens. While Lin et al. (2020) previously developed a capability-based framework, their findings were limited to the industrial sector. By contrast, the present study tested the model across a diverse sample of organizations from the service and product sectors, contributing to its flexibility and potential generalization. Moreover, by translating DC microfoundations into measurable maturity levels, the model refines the theoretical lens by providing empirical access to the distributed nature and uneven development of capabilities across organisations. This perspective contributes to bridging the gap between DC as an abstract construct and their concrete manifestations within the organisational routines of DT.

Compared to earlier frameworks such as Schumacher et al. (2019), the DTDC model offers advantages by exploring microfoundations (e.g., knowledge management and external exploitation), providing more granular and actionable diagnostics. Unlike North et al. (2020), which emphasizes a linear and internally focused process, the DTDC framework promotes an iterative and holistic approach, encompassing the planning and execution of digital strategies aligned with organizational objectives. Furthermore, testing the model within a diverse innovation ecosystem enhances its adaptability and relevance.

On practical implications, the model offers strategic guidance for organizations by helping them assess current capabilities and prioritize investment in transformation. For policymakers, it may inform digital development strategies, particularly in emerging economies where capability-building is a persistent challenge (Scuotto et al., 2021). As SMEs continue facing digitalization barriers, the DTDC model highlights key capability areas to foster resilience and competitiveness. Even for organisations with low digital maturity, the model can serve as a structured starting point, enabling phased improvements and prioritised capability development aligned with strategic goals. Its modular structure also allows gradual adoption, making it particularly suitable for organisations with constrained resources or limited prior experience in DT initiatives.

5. Conclusion

This study advances the DTDC framework by proposing a maturity model grounded in DC and microfoundational logic. It moves beyond linear assumptions by capturing DT's distributed and evolving nature. The model bridges theory and practice, offering diagnostic and strategic value, particularly for organisations with low capability maturity.

However, the sample, limited to Italian firms within a digital innovation observatory, may constrain generalisability due to cultural or sectoral factors. Future research should test the model across broader contexts and integrate performance-oriented indicators. Applying it in developing ecosystems or under institutional fragility may further validate its robustness. Ultimately, the model offers a flexible foundation to assess, scale, and govern digital transformation beyond technology adoption.

Acknowledgements

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Ethics Declaration

Ethical approval was not required for this study. The questionnaire used included an introductory section informing participants about the purpose of the research, assuring anonymity, and requesting their informed consent prior to participation.

AI Declaration

OpenAI's ChatGPT was used to support language refinement and word count adjustments; all content was reviewed and validated by the authors.

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Perspectives on the Development of Green Social Entrepreneurship at Universities in Poland

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Abstract: Green social entrepreneurship is becoming an increasingly important component of sustainable development, as it combines economic objectives with environmental protection and social inclusion. In Poland, universities play a crucial role in promoting this concept; however, comprehensive research on its potential remains limited. The growing interest in the green economy and social entrepreneurship within academic settings highlights the need for deeper analysis. This study aims to evaluate perspectives on the development of green social entrepreneurship at Polish universities, with a particular focus on students' perceptions of its potential, based on the case of the University of the Commission of National Education (UNEC) in Kraków. The main hypothesis assumes that universities in Poland have significant potential to promote green social entrepreneurship, but lack the necessary tools and institutional support, including knowledge of how to apply artificial intelligence (AI) in this field. The study is based on a questionnaire survey conducted among students. The results indicate that universities, such as UNEC, possess considerable potential to advance green social entrepreneurship, although this requires enhanced intersectoral cooperation and improved access to relevant resources. The findings also show that students increasingly recognize the importance of green entrepreneurship for sustainable development. These insights may contribute to the formulation of strategies that support the growth of green social entrepreneurship at Polish universities, including the integration of AI tools to promote sustainability and innovation.

Keywords: Social Entrepreneurship, Green Social Entrepreneurship, Sustainable Development, Universities, AI

1. Introduction

In the face of escalating environmental and social challenges, the role of universities in shaping sustainable and socially responsible attitudes is becoming increasingly significant. Green social entrepreneurship emerges as a promising approach that integrates environmental protection, social inclusion, and innovation within academic ecosystems.

The aim of the article is to evaluate perspectives on the development of green social entrepreneurship at Polish universities, with particular emphasis on students' perceptions of its potential, using the case of the University of the Commission of National Education (UNEC) in Kraków. The article is divided into three main sections: the first reviews the relevant literature, the second outlines the research methodology, and the third presents the key findings of the survey; the article concludes with a summary of conclusions, research limitations, and suggestions for further studies.

2. Literature Review

The role of entrepreneurship in economic development, and its broader understanding, was emerging with Schumpeter's 1949 publication (Schumpeter, 1949). This was a kind of turning point in the perception of entrepreneurship as not only related to starting and running a business (Mehmood et al. 2019). Since then, the scientific world's development of entrepreneurship research has contributed to an increasingly better and more precise understanding of this phenomenon, and has allowed the discovery of new areas in which the importance of entrepreneurship is recognised (Nor, 2024, Klarin, Susneo, 2022, Dacin et al. 2010, World Bank, 2017). One of the research issues closely related to the topic of entrepreneurship is the formation of appropriate pro-entrepreneurial attitudes among young people, as well as the challenges faced by educational institutions (Kurczewska, 2023). Schools, or universities, play a kind of transfer role, the latest achievements, knowledge, innovations and competences to the development of social capital (Audretsch, 2014), which should consequently create an entrepreneurial society. Thus, it should be recognised that educational institutions have a key role in fostering entrepreneurial attitudes. However, what effects will be achieved in the educational process depends on the methods adopted (Marvel, Davis, Sproil, 2016), studies indicate that the most effective method is a combination of practice-oriented and theory-oriented methods (Piperopoulos, Dimov, 2015, Bechard, Gregoire, 2015, Fletcher, 2007). The selection of appropriate educational methods is one element of a properly composed educational model, an equally important element is to follow trends in the economy and, in line with the previous statements, to ensure that students have access to the most up-to-date knowledge in the field as well as the needs of the economy.

One trend increasingly present in the economy is sustainability and green competence (Barth, et al. 2007, Dudur, et al. 2024). This is due to the challenges posed by economic, environmental and social realities, in which increases in productivity and competitiveness take place while reducing the environmental footprint (Biekša et al., 2022). Sustainability is a concept closely related to economic development and these concepts should be seen as complementary, as this approach leads to the creation of economic innovation and improved environmental performance (Voronina, 2024). This cannot be achieved without the proper formation of the human resources that will be the actors of these changes in the future, hence many studies point to the necessity of including courses shaping so-called green competences in educational programmes (Sipos, Battisti, Grimm, 2008, Svanström, Lozano-Garcia, Rowe, 2008, Weik et al., 2011, Mochizuki, Fadeeva, 2010). The very awareness of lecturers and students is also not insignificant, pointing to the need for training in this field, the creation of evaluation tools to measure, among other things, students' green competences in the context of their use in professional practice, as well as interdisciplinary approaches, critical thinking, creativity of managing emotions, social interactions, or teamwork for sustainable development (Cebrián, Junyent, 2015). The development of the aforementioned competences, and consequently of a modern and innovative social capital, is a key role of universities necessary to create spaces for green economic solutions (Ma, 2022). The plethora of research on entrepreneurship, social entrepreneurship, green competences or sustainability points to the relevance of these issues in the contemporary economy. A corollary to this relevance is the importance of education and the involvement of universities in the process of preparing future human resources to effectively create solutions that generate simultaneous economic and social development while reducing the environmental footprint.

3. Methodology

The aim of the research is to evaluate perspectives on the development of green social entrepreneurship at Polish universities based on the opinion of students from the University of the National Education Commission, Krakow (UNEC), Poland.

The following research questions were formulated:

1. How do students at Polish universities engage with and perceive the importance of sustainability in their academic and professional development?
2. To what extent are UNEC students familiar with the concepts of social entrepreneurship and green social entrepreneurship?
3. How do UNEC students perceive the role and effectiveness of their university in promoting green social entrepreneurship?
4. What is the level of awareness and perceived usefulness of artificial intelligence tools in supporting sustainable and socially oriented initiatives among UNEC students?
5. What types of support, educational activities, and workshop formats do UNEC students expect in order to effectively develop competencies in green social entrepreneurship?

It has been hypothesized that universities in Poland have significant potential to promote green social entrepreneurship. However, there is a lack of necessary tools and institutional support, including knowledge of how to utilize AI tools in this area.

The research was conducted at the University of the Commission of National Education (UNEC) in Kraków, Poland, in April and May 2025. The study employed a quantitative method in the form of a survey. A custom-designed questionnaire was developed specifically for the purpose of this research, consisting of 20 questions, both closed and semi-open. Four of these were demographic questions regarding gender, type of studies, year of study, and study mode.

The survey questionnaire was preceded by a short introduction explaining the topic and purpose of the study, the target group, and the voluntary and anonymous nature of participation. Respondents were informed that the survey aimed to gather student opinions on the development prospects of green social entrepreneurship at Polish universities. The instruction also provided contact information for the researchers in case of questions.

The research sample consisted of 224 students from UNEC. Among the respondents, 78% identified as women and 22% as men. In terms of study level, 83% were enrolled in first-cycle (Bachelor's) programs, while 17% were pursuing second-cycle (Master's) studies. The majority of participants (58%) were in their first year of study, followed by 36% in the second year, 4% in the fourth year, and 2% in the fifth year. Regarding study mode, 83% of students were attending full-time programs, and 17% were enrolled in part-time studies. These characteristics

offer a clear overview of the student population surveyed and form a relevant context for interpreting the results related to green social entrepreneurship.

4. Findings

The following section presents the research results structured around the research questions.

How do students at Polish universities engage with and perceive the importance of sustainability in their academic and professional development?

Interest in environmental topics was explored through students' responses on their engagement with sustainability and environmental protection (Figure 1).

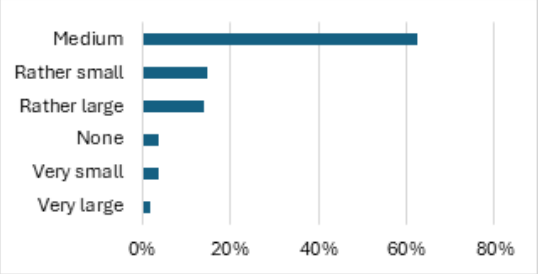


Figure 1: Interest in environmental protection and sustainability topics in the opinion of respondents

Source: own.

The data shows that a clear majority (63%) described their interest as medium, indicating a general awareness and openness to these issues, though not necessarily strong or specialized engagement. About 14% students declared a rather large interest, while roughly 15% reported a rather small interest. Only a marginal number of respondents indicated very small, very large, or no interest at all. This distribution suggests that while most students are moderately interested, relatively few have developed a deeper, more active involvement with environmental protection and sustainability topics.

4.1 To What Extent are UNEC Students Familiar With the Concepts of Social Entrepreneurship and Green Social Entrepreneurship?

When asked whether they had encountered the term social entrepreneurship during their studies, students provided a range of responses (Figure 2). This offers insight into how widely the concept is disseminated within the academic environment.



Figure 2: Familiarity with the term "social entrepreneurship" during studies according to respondents

Source: own.

The majority of respondents (63%) declared that they have come across the term "social entrepreneurship", indicating a noticeable level of exposure to the concept within their academic environment. A smaller but still significant portion of students (23%) stated that they do not recall whether the term was mentioned, which may suggest limited emphasis or a lack of clarity in how the topic was introduced. Meanwhile, a minority of respondents (14%) explicitly answered "No", indicating they had not encountered the term at all.

Awareness of green or eco-social entrepreneurship was also evaluated (Figure 3).

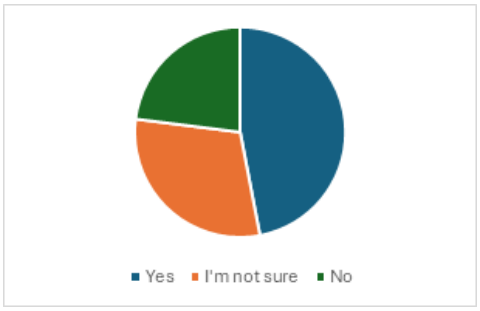


Figure 3: Exposure to the concept of green or eco-social entrepreneurship during studies as reported by respondents

Source: own.

Data shows that 47% of respondents have encountered the concept of green or eco social entrepreneurship during their studies. However, a significant group of respondents (30%) indicated that they are not sure whether they had encountered this concept, which may point to a lack of clarity in how the topic is presented or discussed during classes. A smaller but still notable portion of students (23%) answered "No", suggesting that for some, the idea of eco-social entrepreneurship remains outside their educational experience.

4.2 How do UNEC Students Perceive the Role and Effectiveness of Their University in Promoting Green Social Entrepreneurship?

Perceptions of the importance of green social entrepreneurship for sustainable development were also measured (Figure 4).

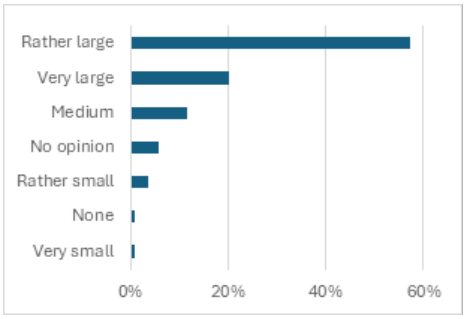


Figure 4: Perceived importance of green social entrepreneurship for sustainable development according to surveyed students

Source: own.

The majority of respondents (57%) believe that the importance of green social entrepreneurship for sustainable development is rather large, and an additional 20% consider it very large, indicating that a vast majority view green social entrepreneurship as a key factor in driving sustainability efforts.

An interesting discrepancy arises when comparing the perceived importance of green social entrepreneurship (with 87% of respondents viewing it as important or very important) and the significantly lower familiarity with the concepts themselves. This suggests a gap between general values and specific knowledge, possibly due to inadequate integration of these concepts into university curricula or low visibility of practical applications within the university ecosystem.

In relation to the role of universities, students shared their views on how actively such institutions should promote green social entrepreneurship (Figure 5).

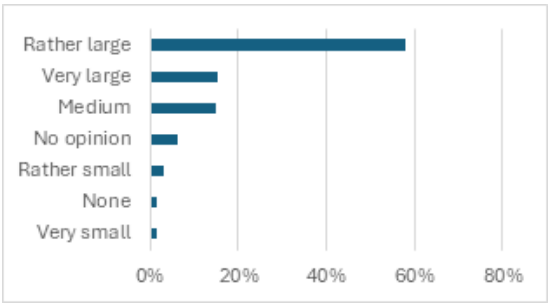


Figure 5: Views on the role of Polish universities in promoting green social entrepreneurship in the opinion of respondents

Source: own.

The results show a strong consensus in favor of active institutional engagement: 58% of respondents rated the desired level of university involvement as rather large, while around 15% selected very large.

Students were also asked how well their university currently supports topics related to environmental protection and sustainability (Figure 6).

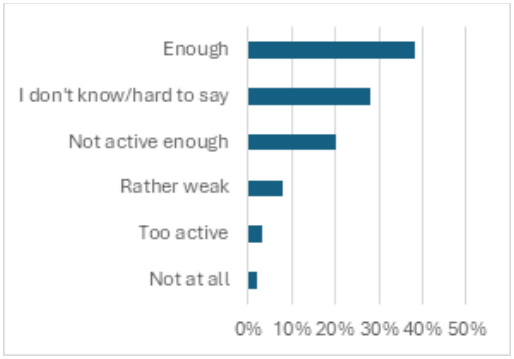


Figure 6: Perception of university engagement in environmental and sustainability topics according to surveyed students

Source: own.

The most common response, selected by nearly 40% of respondents, was that the university does “enough” to promote topics related to environmental protection and sustainable development. Around 30% of students indicated that they don’t know or find it hard to say, which may point to limited visibility or clarity of environmental initiatives on campus. Meanwhile, approximately 20% felt that the university is not active enough, and a smaller group described the activity as rather weak. Only a very small number of respondents perceived the university as too active or not active at all.

Further insights were gathered on how students evaluate their university’s potential to promote green social entrepreneurship (Figure 7).

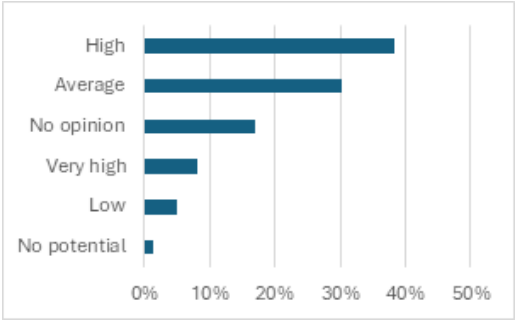


Figure 7: Assessment of university potential in promoting green social entrepreneurship as perceived by respondents

Source: own.

The most frequent response (38%) was “high”, indicating a strong belief in the university’s capacity to engage in and support the promotion of green social entrepreneurship. Additionally, about 30% of respondents rated the university’s potential as “average”, showing a generally positive yet more moderate level of confidence. Approximately 17% of participants selected “no opinion”, which could suggest uncertainty, lack of awareness, or limited exposure to existing initiatives.

4.3 What is the Level of Awareness and Perceived Usefulness of Artificial Intelligence Tools in Supporting Sustainable and Socially Oriented Initiatives Among UNEC Students?

Key barriers and deficits in university support were identified by students (Figure 8).

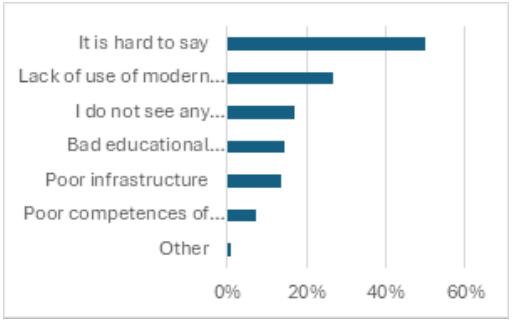


Figure 8: Key deficits in university support for green entrepreneurship in the opinion of respondents

Source: own.

The most frequent response (50%) was “It is hard to say”, suggesting a significant level of uncertainty or a lack of awareness regarding how the university supports (or fails to support) green entrepreneurship. This may reflect either insufficient communication from the institution or a low level of student engagement with the topic. The most commonly indicated concrete deficit was the lack of use of modern technology, selected by around 27% of respondents. This points to a perceived gap in the digital or innovative infrastructure needed to effectively support green entrepreneurial initiatives. Other notable concerns include bad educational programs (14%), poor infrastructure (13%), and the perceived lack of competences among staff or lecturers (7%).

When asked about the role of artificial intelligence (AI) in supporting green social entrepreneurship, students showed varied perceptions (Figure 9).

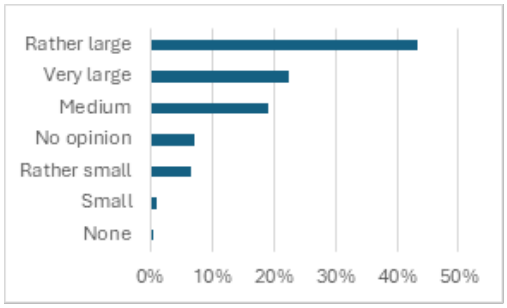


Figure 9: The role of AI tools in supporting green social entrepreneurship according to respondents

Source: own.

According to 43% of surveyed students, the potential of artificial intelligence (AI) tools in supporting the development of green social entrepreneurship is considered “rather large.” This indicates a widespread belief in the usefulness of AI for advancing environmentally and socially responsible entrepreneurial initiatives. An additional 22% rated the potential as “very large”, further emphasizing strong optimism about AI’s role in this area. Around 19% of respondents selected “medium”, showing that while they recognize the possible contributions of AI, they may view them as more limited or conditional on specific factors such as implementation quality or context.

4.4 What Types of Support, Educational Activities, and Workshop Formats do UNEC Students Expect in Order to Effectively Develop Competencies in Green Social Entrepreneurship?

Interest in acquiring knowledge about AI in ecological or social contexts was also explored (Figure 10).

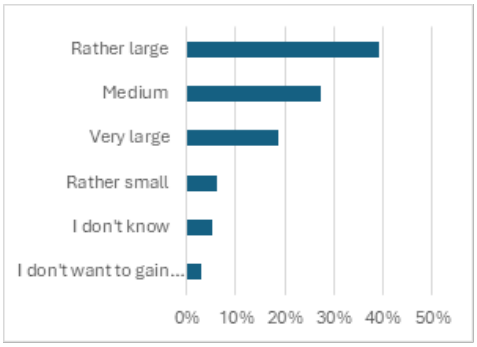


Figure 10: Interest in learning about the use of AI in environmental or social initiatives as expressed by respondents

Source: own.

The most common response, selected by 39% of students, was “rather large”, indicating a strong overall willingness to explore how AI can contribute to environmental and social initiatives. Approximately 27% of respondents expressed a medium level of interest, while around 20% showed very large interest, which together reinforce the idea that this is a highly relevant and engaging topic for the majority of students.

Students proposed various actions that universities could take to better support green social entrepreneurship (Figure 11).

The sum of the response percentages in the chart is greater than 100% because respondents could choose more than one answer.

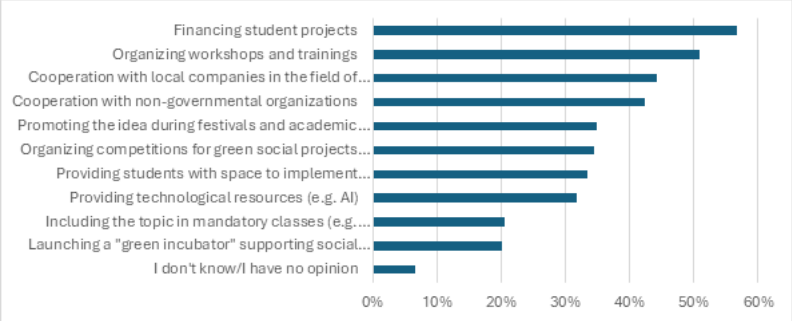


Figure 11: Suggested university actions to better support green social entrepreneurship in the opinion of respondents

Source: own.

The most frequently selected answers—selected by 57% of respondents—was financing student projects, clearly signaling that access to funding is seen as a key enabler for student-driven initiatives in this area. Closely following were suggestions such as organizing workshops and trainings (51%) and fostering cooperation with local companies (44%) and non-governmental organizations (42%) involved in green entrepreneurship. These results emphasize the importance of building practical skills and creating connections between the university environment and real-world stakeholders. Other frequently mentioned actions include promoting green social entrepreneurship during festivals and academic events, organizing competitions with prizes, and providing students with space and resources (including technology such as AI) to implement ecological and social projects.

As part of this support, students were also asked to indicate which training topics or workshop themes they would find most relevant (Figure 12).

The sum of the response percentages in the chart is greater than 100% because respondents could choose more than one answer.

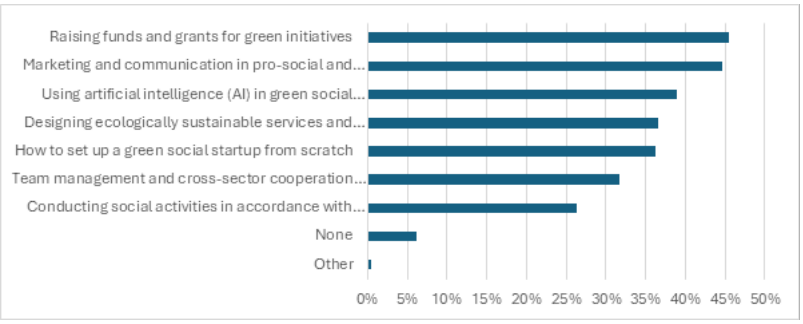


Figure 12: Training or workshop topics in green social entrepreneurship of interest to respondents

Source: own.

The most frequently selected themes—each chosen by nearly half of the respondents—were raising funds and grants for green initiatives (46%) and marketing and communication in pro-social and ecological projects (45%). These results indicate a strong interest in acquiring practical, actionable skills that are essential for launching and sustaining successful green social ventures. Other highly valued topics include the use of artificial intelligence (AI) in green social entrepreneurship (39%), designing ecologically sustainable products and services (37%), and how to start a green social startup from scratch (36%). These preferences reveal that students are not only interested in theoretical knowledge but also in tools and methods for innovation, implementation, and digital integration. Additionally, students expressed significant interest in team management and cross-sector cooperation (32%)—particularly between NGOs, universities, and businesses—as well as conducting social activities based on zero waste principles (26%), showing a broader awareness of operational and collaborative dimensions of sustainability.

Finally, students' willingness to participate in a university-led program supporting green social entrepreneurship was measured (Figure 13).



Figure 13: Willingness to participate in a program supporting green social entrepreneurship according to respondents

Source: own.

The majority of respondents (58%) selected "Maybe", indicating an openness to participation, though likely dependent on specific program details such as format, content, time commitment, or perceived value. A considerable portion of students (30%) also responded "Yes", which demonstrates a clear interest and motivation among part of the student body to actively engage in such initiatives. This confirms the relevance of green social entrepreneurship as an area worth developing within university support structures.

5. Conclusion

The results of the study lead to several important conclusions. They indicate a solid foundation of awareness among students regarding environmental protection and sustainability, while also revealing potential for universities to further nurture this interest through targeted education and institutional support. The concept of social entrepreneurship is moderately disseminated within higher education, highlighting an opportunity for universities to enhance its visibility through curriculum integration and student engagement.

The findings reveal strong student support for a proactive university role in promoting green social entrepreneurship. This reflects an expectation that higher education institutions not only share knowledge but also model values consistent with sustainability and social responsibility.

Students generally perceive their universities as having a reasonable foundation for advancing green social entrepreneurship; however, they also identify gaps, particularly in communication and visibility of existing initiatives. Addressing this requires structural improvements—such as integrating modern technologies—and greater transparency about current efforts.

Another key insight relates to the perceived role of AI in supporting sustainable, socially conscious business models. A high level of student recognition suggests growing awareness of how technology can address ecological and social challenges. This opens opportunities for universities to develop curricula that connect AI with sustainability.

Students also express interest in learning how AI can be applied to ecological and social causes. This highlights the need for interdisciplinary programs that bridge technology with sustainable development goals.

There is a clear desire for more structured and visible institutional support. The findings reflect a strong call for universities to adopt a well-resourced, practical approach to fostering green social entrepreneurship through funding, mentorship, infrastructure, and partnerships.

Finally, the results underscore demand for interdisciplinary, future-oriented education that combines sustainability, entrepreneurship, technology, and communication. This offers universities clear direction in designing workshops and training aligned with student interests and global challenges.

Overall, students demonstrate a generally positive or cautiously optimistic attitude toward participating in green social entrepreneurship programs. This provides a strong foundation for targeted initiatives that foster innovation and sustainability while meeting student expectations.

The main hypothesis assumed that Polish universities possess significant potential to promote green social entrepreneurship but lack tools, institutional support, and AI-related knowledge. Findings from UNEC confirm this, highlighting the need for strategic actions, improved communication, and enhanced resources.

This study was limited to students of a single university (UNEC, Kraków), which may affect the generalizability of results. The self-reported questionnaire also introduces possible bias. As a cross-sectional study, it captures a single moment in time. A larger, more diverse sample would improve the robustness of the findings.

Although the study offers valuable insights, it does not exhaust the topic. Future research should include multiple institutions, regional comparisons, and longitudinal or qualitative approaches to explore the evolving role of green social entrepreneurship in higher education.

These findings are consistent with previous studies (e.g., Klarin & Suseno, 2022), which emphasize the need for structured institutional frameworks to operationalize sustainability goals within academic entrepreneurship. Therefore, while students' perceptions are subjective, they reflect broader educational and policy trends.

Ethics Declaration

In accordance with ethical research standards, each participant was presented with a consent statement. This included confirmation of being informed about the purpose and nature of the study, their right to withdraw at any time, and the assurance that the data collected would be used solely for research purposes. A separate clause informed respondents about personal data processing in compliance with applicable data protection regulations.

AI Declaration

Artificial intelligence (AI) tools were used during the preparation of this article to support the revision process. Specifically, AI-assisted language models (such as ChatGPT by OpenAI) were employed to check grammatical accuracy, improve stylistic consistency, enhance clarity, and ensure coherence throughout the text. All intellectual content, research design, data interpretation, and conclusions were generated and validated by the authors. The use of AI was limited to editorial assistance and did not replace the authors' critical analysis or academic responsibility.

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Innovation Platforms: A New Perspective to Unleash the 5G Potential for MNOs

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Abstract: The current economic situation of Mobile Network Operators (MNOs) is far from flourishing, as the entire telecommunications industry faces financial challenges. Meanwhile, the rapid development of emerging technologies, particularly 5G, presents new strategic opportunities. Unlike previous connectivity generations, 5G is not merely an enhancement but a foundational enabler for application services, especially in the enterprise sector. Beyond its intrinsic nature as a connectivity infrastructure, 5G may serve as an innovation platform to foster the development of new business models and services. This technological shift offers MNOs a unique chance to reposition themselves within the mobile telecommunications ecosystem, avoiding the risk of becoming "commodity providers", limited to selling connectivity per se. This study explores how MNOs can leverage 5G as an innovation platform to transform their business models and regain a central role in the telecommunications sector. Through a multiple-case study in the Italian market, findings show that MNOs are gradually transitioning from basic connectivity providers to platform orchestrators focused on service integration and value co-creation. The study advances current literature by framing 5G as an innovation platform and offers practical insights into platform governance and strategic repositioning.

Keywords: 5G, Business Model, MNO, Innovation Platform, Orchestrator

1. Introduction

The current landscape for Mobile Network Operators (MNOs) is far from thriving, as the entire industry faces significant economic pressures. For instance, in Italy alone, MNOs experienced a 35% decline in revenues between 2010 and 2023. At the same time, a range of emerging technologies is advancing rapidly. Among them, 5G stands out due to its transformative potential compared to previous generations of connectivity (Gooderham et al., 2022). Rather than being just another means of internet access, 5G introduces capabilities that make it a robust foundation for developing new application services, particularly in the enterprise segment. These new possibilities represent a critical opportunity for MNOs to reassert their influence in the mobile telecommunications market, following a period in which they have been increasingly perceived as mere providers of commoditized services (Cave, 2018).

In Italy, the regulatory framework adds a unique element to this dynamic, as only MNOs are authorized to obtain licenses for spectrum access. This regulatory specificity introduces an important contextual factor to be considered in the analysis. While 5G has sometimes been described as an innovation platform (Ahokangas et al., 2021), the topic has been investigated mainly from a technical perspective. This makes it worthwhile to explore platform literature more deeply, particularly its emphasis on the shift from resource control to orchestration, from internal efficiency to external collaboration, and from product value to ecosystem value (Van Alstyne et al., 2016). In this light, 5G's modular architecture, use of open-source tools, and support for APIs position it as a potential enabler of decentralized innovation. However, this openness also requires MNOs to redefine their role. The study addresses the following research question: "How can MNOs resume a relevant role in the mobile telecommunication ecosystem through the usage of 5G intended as an innovation platform?".

The research is carried out through an exploratory multiple-case study focusing on key actors in Italy's 5G industry (Eisenhardt, 1989). The data analysis follows the Gioia methodology (Gioia, 2013). The findings reveal that 5G can be framed as an innovation platform rather than mere connectivity, enabling critical services and modular, scalable applications (Gawer, 2021; Singh & Kapoor, 2024). However, its full potential remains constrained by market immaturity, delayed infrastructure upgrades, and limited monetization opportunities (Cave, 2018; Gooderham et al., 2022). MNOs are repositioning themselves as platform orchestrators, seeking to coordinate resources and deliver end-to-end solutions (Cennamo, 2018; Jacobides et al., 2024). Therefore, the study sheds light on the evolving role of MNOs as potential ecosystem orchestrators, without claiming to offer final conclusions given the ongoing nature of the transformation under study. It also outlines practical

recommendations: MNOs should strive to position themselves as platform orchestrators by embracing partnerships and open innovation. Their long-term success will depend on effective branding, ecosystem governance, and internal structural changes.

2. Literature Review

2.1 MNO Challenges With 5G Technology

The development of the mobile telecommunications industry and the evolving role of Mobile Network Operators (MNOs) can be divided into three distinct phases (Gooderham et al., 2022). The first phase, spanning from 1990 to 2010 and marked by the 2G and 3G eras, saw MNOs occupying a dominant position in the market (Ghezzi et al., 2015). As the sole providers of voice and SMS services, they were able to achieve high profitability. However, by the early 2000s, rising competition among operators led to intense price wars, which severely eroded their profit margins. At the same time, the industry landscape began to shift, with new prospects arising in web-based, media, and ICT services. This transition introduced significant disruption and altered the market equilibrium (Ghezzi, 2013).

The second phase, associated with the rise of 4G and taking place between 2010 and 2020, reflects a period of decline for MNOs. During this time, they failed to respond effectively to shifts in the external environment, neglecting to expand into the multimedia content space (Lehr et al., 2021) and continuing to focus exclusively on connectivity. In contrast, other actors such as Over The Top (OTT) players recognized and capitalized on the new market opportunities (Cave, 2018), further diminishing the strategic relevance of MNOs (Gooderham et al., 2022).

The third and current phase began in 2021 with the arrival of 5G technology. This latest generation of connectivity brings significant potential, particularly in the B2B domain, to reshape MNOs' business models and help them regain competitiveness following their inability to fully exploit the 4G era (Lehr et al., 2021).

5G technology represents a sophisticated and high-potential technological advancement with the capacity to support a wide array of applications (5G PPP, 2016; Cave, 2018; Ahokangas et al., 2021). From an academic perspective, 5G is frequently conceptualized as an enabling technology (Teece, 2018; Rathje and Katila, 2021; Gambardella et al., 2021). However, it has not yet achieved the status of a General-Purpose Technology (Bresnahan and Trajtenberg, 1995), primarily due to its limited diffusion and economic pervasiveness. According to Bauer and Bohlin (2022), and based on current use cases, 5G appears to be primarily oriented toward enterprise and industrial markets, rather than the mass consumer segment traditionally served by MNOs.

2.2 Innovation Platform

Platform-based businesses have transformed numerous industries, and the literature identifies five main types of platforms. These include internal platforms, which consist of tools and resources that support a modular approach to developing related products (Gawer & Cusumano, 2014); supply chain platforms, which serve to streamline resource coordination and improve operational efficiency (Gawer, 2014); multi-sided platforms, which act as intermediaries connecting distinct user groups and benefiting from network externalities (Trabucchi & Buganza, 2021); innovation platforms, which provide a foundation for third-party developers to build complementary technologies or services using standardized modular components that help foster an ecosystem (Gawer, 2021); and hybrid platforms, which aim to leverage synergies by combining different platform features (Jacobides et al., 2024).

Platforms derive their value primarily from network effects, meaning their attractiveness grows as more users join, enhancing both scale and efficiency. Their digital nature further allows them to expand and adapt quickly, while ensuring that value capture remains centralized (Gawer, 2021). Transaction platforms, in particular, reduce barriers to exchange by directly linking users (Jacobides et al., 2024), thereby minimizing market inefficiencies (Bonina et al., 2021). Innovation platforms, meanwhile, promote external innovation by enabling collaboration among a wide array of stakeholders (Gawer & Cusumano, 2014), who often rely on one another in a mutually interdependent relationship (Rietveld et al., 2019).

In innovation platforms, the final offering results from the contributions of multiple actors, with external developers adding essential complementary components. The role of the orchestrator is to ensure that value is distributed fairly among participants in proportion to their contributions (Jacobides et al., 2024).

Scholars have outlined the diverse roles that actors play within platform ecosystems. On innovation platforms, end users represent the recipients of the final offering (Gawer, 2014), while complementors or developers play a vital part in enhancing the platform by producing add-on products or services (Cennamo, 2018). Platform owners hold a central governance role, responsible for overseeing platform operations and steering strategic decisions to ensure its success.

Effective platform governance involves managing four key areas. First, defining the scope of the firm, or which elements should be developed internally (Gawer & Cusumano, 2014). Second, managing the technological architecture, striking a balance between openness and control to draw in innovators while preserving the platform's stability and quality (Jacobides et al., 2024). Third, making informed decisions about when to open the platform to external contributors, depending on their readiness and the platform's maturity (Parker & Van Alstyne, 2018). Fourth, nurturing relationships with complementors and establishing governance rules that shape the contributions of external developers (Singh & Kapoor, 2024). Lastly, it is essential to design internal structures and processes that support the resolution of critical issues (Gawer & Cusumano, 2014).

3. Objective and Methodology

Although platforms have disrupted multiple industries, the literature distinguishes different typologies, including multi-sided platforms, supply chain platforms, and innovation platforms. Innovation platforms, in particular, enable third-party developers to create complementary products and services by leveraging modular technological standards. Therefore, beyond its intrinsic nature as a connectivity infrastructure, 5G may serve as an innovation platform to foster the development of new business models and services.

Thus, this study investigates how MNOs can leverage 5G as an innovation platform to regain a central role in the telecommunications industry, addressing the following research question: How can MNOs resume a relevant role in the mobile telecommunication ecosystem through the usage of 5G intended as an innovation platform?

To investigate the dynamics at the core of this study, a qualitative approach was considered the most suitable (Eisenhardt, 1989). Given the difficulty of formulating testable hypotheses in advance and the likelihood that theoretical insights would emerge from empirical evidence, the research followed an exploratory case study methodology (Yin, 1984). This approach is particularly relevant because the research not only addresses existing gaps in the literature but also provides valuable guidance for MNOs currently undergoing a transformation. These organizations must be aware of both the limitations they face and the opportunities available to them. The focus of the analysis is the transformation process of MNOs in the 5G era, making it the central unit of investigation. The study is specifically contextualized within the Italian market, where the regulatory framework restricts spectrum access exclusively to MNOs.

For this reason, the sampling included all three Italian MNOs (MNO A, MNO B, MNO C), along with a mobile virtual network operator (MVNO A) that is particularly active in the enterprise segment. In addition, to capture a broader range of perspectives on the transition process, we decided to include additional stakeholders in order to observe the ongoing transformations of MNOs from alternative perspectives. We therefore included three system integrators (SI A, SI B, SI C), and one real-world end user that adopted 5G (Use Case A).

Data were gathered primarily through semi-structured interviews, chosen for their flexibility in allowing participants to share rich, detailed information (Yin, 1984). A total of 11 interviews conducted across the 8 case subjects served as the main data source, directly addressing the research question.

To enhance the robustness of the analysis, the sample was supplemented with additional materials: 1 podcast, 7 YouTube videos, 5 news articles, 11 industry reports, and 3 corporate websites. These secondary sources were used to triangulate the interview data, thereby improving the study's reliability and verifying whether additional relevant insights had been overlooked. A within-case analysis was carried out to gain familiarity with the data, followed by a cross-case comparison to synthesize patterns across the sample. Subsequently, quotes were grouped into first-order codes, second-order themes, and overarching dimensions. The combined use of informant-based categories (1st order) and academically grounded themes (2nd order) enabled a rigorous, qualitative representation of the connections between the data and the research question (Gioia et al., 2013).

4. Findings

The coding process brought to light several themes that emerged from the data, which were organized into three dimensions: the concept of 5G as an innovation platform, 5G market friction and resource orchestration.

4.1 5G as an Innovation Platform

Interviewees unanimously emphasized that 5G extends far beyond basic connectivity, describing it as a "*horizontal enabler with edge data centres*" (MVNO A) that forms the foundation to "*support a wide range of applications*," deliver "*innovative solutions*," and enable "*business-critical services*" (MNO C), a view also reinforced by Use Case A. Despite these expectations, the full realization of 5G's potential is hindered by delays in technological development (MNO A; SI A) and a market that remains unprepared to adopt 5G-based solutions.

Insights from the international Use Case A, based outside of Italy, highlight that 5G spectrum liberalization has accelerated development by enabling private entities to conduct low-cost and flexible testing. Technologically, 5G is designed as a modular, layered architecture composed of standardized elements that offer both flexibility and scalability (MNO A), allowing providers "*to respond in a multidimensional way to multidimensional service needs*" (MNO C). According to Use Case A, "*there will be basic components that might fit all*," suggesting that standard building blocks can improve solution replicability. In fact, the "whitebox" hardware employed is open-source and programmable, thanks to the use of Application Programming Interfaces (APIs). These APIs operate under an open development model, enhancing accessibility and facilitating innovation by enabling third parties to independently contribute.

However, the openness of these interfaces can also introduce vulnerabilities, potentially compromising the quality and security of network solutions. For this reason, MNOs place particular emphasis on carefully selecting trustworthy and reliable partners. Therefore, collaboration and interoperability are essential (SI A), with strategic partnerships playing a critical role in delivering comprehensive and cutting-edge solutions. Nevertheless, such collaboration is not without its challenges, especially in terms of communication barriers between different stakeholders (SI C).

4.2 5G Market Friction

The data reveal that connectivity is widely perceived as a commodity, making it difficult to monetize 5G services in the consumer market. This segment typically yields minimal margins: "*no one is willing to pay a significant price*" (SI C). According to SI C, "*the operator has fundamentally lost its positioning*," largely due to the rise of OTT players and the introduction of the iPhone, both of which leveraged MNOs merely as passive conduits for their services without compensating them for the use of the network (MNO A).

Even though they are trying to specialize in various verticals, as also evidenced by secondary sources and the offerings on their websites, another key issue for MNOs lies in their limited ability to effectively communicate the true value of 5G to enterprise companies, who remain hesitant to support the investment in the absence of clear, practical use cases. This underscores the importance of delivering real-world applications to "*help these companies understand what they can do with 5G*" (MNO C).

The data reveal that connectivity is broadly perceived as a commodity, making it difficult for MNOs to extract value from 5G services in the consumer market, which typically generates low margins: "*no one is willing to pay a significant price*" (SI C).

Also, in 5G enterprise market, on the supply side, MNOs struggle to effectively articulate the concrete value that 5G can deliver, especially in terms of innovative applications and industry-specific use cases. Despite the technological capabilities of 5G, these remain abstract and intangible to enterprise customers, who find it difficult to justify investment without a clear and immediate return. On the demand side, companies express a general reluctance to adopt 5G solutions due to uncertainty regarding its practical benefits, integration costs, and operational relevance. As MNO C notes, this hesitation underscores the urgent need for tangible examples that "*help these companies understand what they can do with these platforms*."

This mutual disconnect creates a market friction, where the technological offer advances faster than its business comprehension and perceived utility

As a result, MNOs find themselves in a "*moment of great redefinition*" (SI B), attempting to reposition themselves as integrators or coordinators across various roles (MNO B). Their goal is to deliver "*end-to-end service management*" overseeing the entire process "*from requirements to implementation*" (MNO C).

4.3 Resource Orchestration

Through this orchestration of resources, MNOs aim to establish themselves as central players in 5G deployment (MNO A), offering the most complete and integrated solutions (MNO C). However, they often lack the domain-specific expertise required to meet the needs of individual vertical industries (SI A), resulting in "*knowledge gaps in their understanding of use cases*" (Use Case A). To address this, MNOs are not only relying on specialized partners but are also internally reorganizing around industry verticals and investing in upskilling programs to build dedicated capabilities.

This transformation is enabling a shift toward a more consultative role (MNO A), strengthening pre-sales competencies and enhancing the ability to articulate the strategic value of 5G for specific sectors. MNOs are building "*transverse process competencies*" and creating dedicated professional roles capable of assessing end-to-end 5G solutions and guiding customers through their complexity.

The development of 5G offerings is thus increasingly market-driven (MNO B), and MNOs are positioning themselves as unique touchpoints within the ecosystem, able to mediate between industry needs and partner capabilities. This role requires not only coordination skills but also a degree of influence over partner orchestration, which reinforces their strategic position.

5. Discussion

Empirical evidence highlights the increasing effort by Italian MNOs to assume the role of platform orchestrators (Cennamo, 2018; Jacobides et al., 2024). This role goes beyond technical coordination of the platform: MNOs must also govern relationships between technical complementors and clients, managing an interdependent web of interactions that is crucial for value creation (Rietveld et al., 2019). In markets like Italy, where MNOs own a critical asset such as 5G spectrum licences, the risk of being perceived as mere connectivity providers is high. However, literature warns that such a positioning risks commoditization and loss of strategic advantage (Cave, 2018, Gooderham et al., 2022). Instead, MNOs should evolve their competencies to encompass ecosystem governance, orchestrating rather than owning the key components of value generation. For instance, MNOs can become the unique touchpoint with the end customer, managing the complexity arising from the presence of multiple actors involved in delivering the offering and implementing 5G use cases within the client company. There are currently some collaborations aiming in this direction

This shift aligns with broader platform strategy literature, which emphasizes the move from resource control to resource orchestration, from internal optimization to external interaction, and from product value to ecosystem value (Van Alstyne et al., 2016; Parker & Van Alstyne, 2018). In the 5G context, this includes making critical decisions around platform openness, such as exposing APIs to enable external innovation and decentralize development. Indeed, the use of shared APIs (Bonina et al., 2021) and open-source software incentivize the development of innovative features and functionalities attracting different entities in the creation of components. So, it has the positive effect given by the increment of accessibility (Gawer & Cusumano, 2014) and external collaboration, but on the other side there is the higher vulnerability of an open network. 5G's architectural features, standardized hardware, open-source tools, and modularity, align well with innovation platform logics, but require MNOs to strike a governance balance: enabling access for external developers while ensuring performance and security standards are upheld (Gawer, 2021; Singh & Kapoor, 2024). Literature on platform governance stresses that this equilibrium is essential to maintain network health and to avoid value-destroying behaviors (Van Alstyne & Parker, 2017).

Such openness fosters engagement and variety, as theorized for innovation platforms (Cusumano et al., 2019), and contrasts with past "*walled garden*" models, such as those seen during the 3G era, where MNOs sought to control the entire service stack (Ghezzi et al., 2015). That approach failed to deter the rise of Over-The-Top (OTT) actors who capitalized on openness and scale (Lehr et al., 2021; Gooderham et al., 2022). Therefore, defining a clear orchestration strategy early in the 5G evolution may be critical to restoring competitive positioning.

Moreover, MNOs' investment in vertical expertise and internal organizational structures reflects the dual governance challenge discussed by Gawer and Cusumano (2014): the need to coordinate internal processes while setting fair rules for external contributors.

Here below Figure 1 represents the main findings.

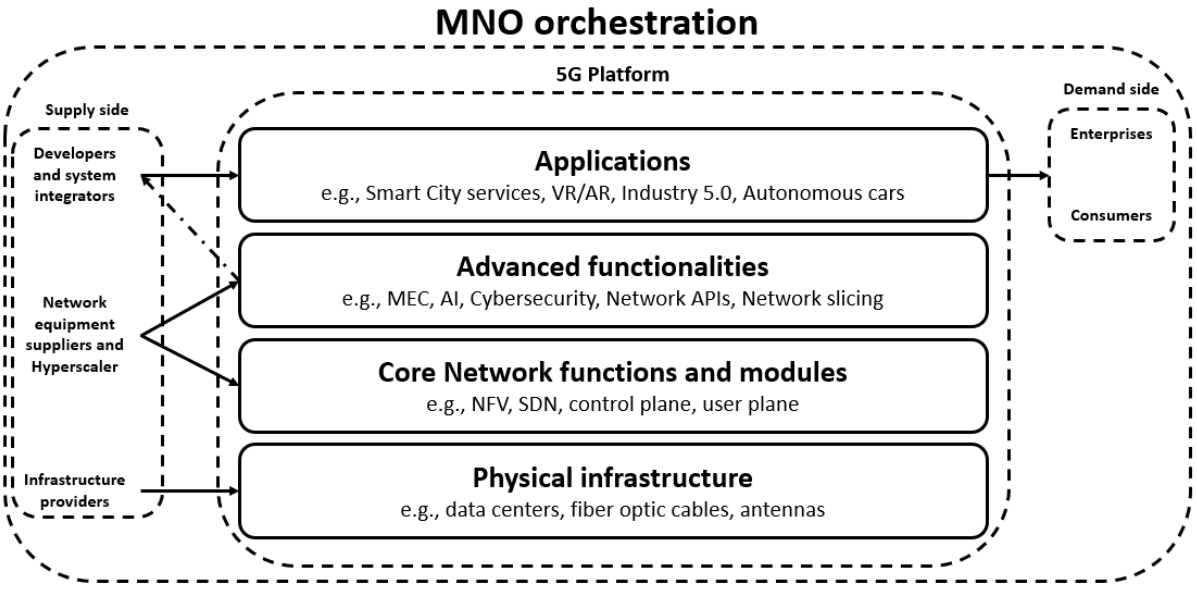


Figure 1: 5G as a Platform framework

As shown in Figure 1, the 5G Platform framework is composed of 4 main elements: the technological platform, the supply side, the demand side, and the platform orchestrator. The technological platform is composed of 4 layers, from the physical infrastructure to the applications used by companies, passing through core network and advanced functionalities and modules. Many actors, from the supply side, contribute to enrich the platform and add functionalities or assets needed to continuously evolve. In particular, infrastructure providers contribute with physical infrastructure, which is the first layer on which adding functionalities. Then, network equipment suppliers and Hyperscalers contribute to the platform enrichment with core network and advanced functionalities and modules, which allow developers and system integrators to take the latter and developing new applications for the demand side. This side is composed of both enterprises and consumers. In this platform ecosystem (Jacobides et al., 2024) is required the presence of an orchestrator to govern and manage the multiple set of relationships. MNOs, thanks to their capabilities and expertise in this industry, can assume this role of orchestrator, to move from a logic of general commodity supplier to the logic of a unique touchpoint to access to the 5G Platform functionalities, to develop applications, and to buy these applications. By doing so, the MNO can act as a catalyst in addressing market frictions and connecting demand and supply side (technology provider side). The focus shifts from resource ownership to resource orchestration, and the dashed line refers to this central role of the MNO in enabling a better alignment between demand and supply, with 5G functioning as an innovation platform.

5.1 Theoretical Contributions

In some papers in the managerial domain dealing with 5G, the concept of 5G has already been associated with the broader notions of platforms (Henríquez et al., 2022; Ahokangas et al., 2021). However, such perspectives have primarily been used to map the actors involved (Bauer & Bohlin, 2022; Teece, 2021), and the boundary conditions of these studies are often quite context-specific and restrictive. From these contributions, the challenge related to identifying the role of an “orchestrator” (Bauer & Bohlin, 2022) or a “central player” (Ahokangas et al., 2021) has emerged. In other words, the importance of having a stakeholder able to coordinate across all layers of the system has been emphasized.

This study represents an early attempt to conceptualize 5G as an innovation platform, contributing to the limited body of work that frames 5G not only as a technological infrastructure. Indeed, by applying this theoretical lens, the analysis reveals some of the structural and organizational challenges that MNOs face, while offering a novel interpretation of 5G’s potential that goes beyond purely technological aspects. Within this framework, the idea of MNOs as central orchestrators emerges as a plausible, though not predetermined, scenario, rooted in both the empirical evidence and the conceptual foundations of platform theory. However, given the evolving nature of the technology, the study does not propose definitive conclusions; instead, it outlines a trajectory concerning MNOs’ business models during the ongoing technological transition (Tongur & Engwall, 2014).

5.2 Practical Contributions

The study presents also some practical contributions. First, MNOs must become aware of their current market perception, which often reduces them to commodity providers (Cave, 2018). In this view, basic connectivity is no longer a differentiator but a baseline expectation. To gain a competitive edge, MNOs need to develop and deliver value-added services built on top of their infrastructure.

The current moment presents MNOs with a strategic opportunity similar to the one they missed during the transition from 3G to 4G, when they failed to capitalize on the value shift driven by media and content platforms (Ghezzi, 2013; Lehr et al., 2021). Given their structural limitations and lack of domain-specific expertise (Gooderham et al., 2022), MNOs should not aim to internalize all innovation but rather focus on building capabilities to coordinate external contributors and govern the platform.

Still, achieving this orchestrator role is no easy task. MNOs must navigate intense competition and overcome entrenched market perceptions that limit their strategic repositioning. Therefore, they must proactively lead this transformation, leveraging internal restructuring, strategic partnerships, and ecosystem engagement to reinforce their legitimacy and relevance in the emerging 5G landscape.

6. Conclusion

This study investigated how Mobile Network Operators can leverage 5G through the lens of innovation platforms to regain a strategic role within the mobile telecommunications industry. Using a qualitative multiple-case approach involving eight exploratory cases, the research identified three key theoretical dimensions: 5G as an innovation platform, 5G market frictions and resource orchestration. The resulting framework connects the characteristics of 5G and its ecosystem with platform-based logics, offering fresh insights into MNOs' potential orchestration roles without asserting deterministic outcomes. Despite these contributions, the research is limited by its qualitative nature, a small and sensitive data set, and the rapidly evolving context of 5G. Future research could address these limitations through comparative or longitudinal studies to capture long-term impacts on MNO repositioning.

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Ethics and AI Declarations

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The Effect of Media and Social Capital on Entrepreneurial Intention and Behaviour: Does Gender Really Matter?

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Abstract: High unemployment rates have increased the importance of entrepreneurship. As a result, encouraging individuals to become self-employed is considered a viable solution for job creation. Since entrepreneurial activity is driven primarily by individuals' intentions, it is vital to identify and assess the drivers of entrepreneurial intention and behaviour. This will help policymakers to develop and implement support programmes that could assist individuals to start their own businesses. This study examined how media, social capital, and gender influence the key determinants of entrepreneurial intention and intention among university of technology and TVET college students in Gauteng, South Africa. Additionally, the study investigated the effects of perceived behavioural control and entrepreneurial intention on entrepreneurial behaviour. Data were collected from 496 final-year TVET and university of technology students using a structured, self-administered online questionnaire. Partial least squares structural equation modelling was applied to test the hypotheses. Media and social capital were positively related to all the three determinants of entrepreneurial intention: attitude towards entrepreneurship, perceived behavioural control, and subjective norms. While the media directly and significantly influences entrepreneurial intention, social capital does not. Gender was negatively related to both attitude towards entrepreneurship and perceived behavioural control but showed no significant impact on subjective norms. Attitude towards entrepreneurship and perceived behavioural control significantly influenced entrepreneurial intention, while subjective norms showed no significant effect. Entrepreneurial intention and perceived behavioural control had a direct, positive relationship with entrepreneurial behaviour. Attitude towards entrepreneurship and perceived behavioural control partially mediated the effects of the media on entrepreneurial intention. Perceived behavioural control partially mediated the effects of social capital on entrepreneurial intention. These findings suggest that leveraging both the media and social capital while accounting for gender differences could have a positive influence on entrepreneurial intention and entrepreneurial activity. These findings are valuable for entrepreneurship educators and policymakers in their efforts to implement interventions aimed at encouraging the youth to pursue entrepreneurship.

Keywords: Theory of Planned Behaviour, Media, Social Capital, Gender, Entrepreneurial Intention, Entrepreneurial Behaviour

1. Introduction

Entrepreneurship has emerged as a vital contributor to economic growth around the world (Al-Ghani et al., 2022; Bowmaker-Falconer et al., 2023). Consequently, many governments, especially those grappling with unemployment challenges, continue to promote entrepreneurship as a strategy to combat rising joblessness and poverty (Bowmaker-Falconer et al., 2023). South Africa, like many other developing countries, is contending with a persistently high unemployment rate (Statistics South Africa, 2025), while on the other hand the country's total entrepreneurial activity rates and entrepreneurial intentions (EIs) have declined (Bowmaker-Falconer et al., 2023). This problem is worsened by a notable gender disparity in early-stage business participation, with women at 9.7% compared to men at 12.7% (Bowmaker-Falconer et al., 2023) and lower EIs of women compared to men (Malebana and Vhukeya, 2023). In response, policymakers, researchers, entrepreneurship educators, and the government continue to make concerted efforts to understand the factors influencing EI and behaviour (Bowmaker-Falconer et al., 2023). An understanding of these influencing factors could guide the formulation of policies and the design of interventions aimed at facilitating entrepreneurship development (Mothibi and Malebana, 2019; Malebana, 2021).

Prior research suggests that the establishment of new ventures is driven by individuals' intentions (Joensuu-Salo et al., 2020; Nergui, 2020; Krueger et al., 2000). EIs can be shaped by the social circumstances (Liñán and Santos, 2007; Malebana, 2016). This implies that one's intention to behave entrepreneurially is influenced by dominant factors such as cultural norms and beliefs, perceptions, assumptions and attitudes concerning entrepreneurship in a particular society (Adekiya and Ibrahim, 2016; Ataei et al., 2020). Media and social capital can play a vital role in influencing societal norms, beliefs, perceptions, assumptions and attitudes. Media communications shape the behaviour of individuals by informing, enabling, motivating, and guiding them, thereby influencing public opinion, knowledge, beliefs, and attitudes (Bandura, 2001). Surprisingly, a limited number of studies have investigated the role of the media in fostering EIs and behaviour (Adekiya and Ibrahim, 2016; de Pillis and Reardon, 2007; Levie et al., 2010; Mothibi and Malebana, 2019).

Many entrepreneurship scholars emphasise the important role of social capital in fostering EIs (Ha et al., 2020; Malebana, 2016) and entrepreneurial behaviour (EB) (Babajide et al., 2022). Previous studies show that individuals who believe that their social networks will provide them with the resources and support they need when starting business are more likely to develop strong intentions of becoming entrepreneurs (Ramírez-Lemus et al., 2023). Given that the efforts exerted towards setting up a new venture can be risky (Anwar and Saleem, 2019), social networks enhance entrepreneurs' confidence in their ability to cope with uncertainty and their willingness to take risks associated with opportunity exploitation (Rodríguez-Gutiérrez et al., 2020), thereby reducing the likelihood of failure.

While extensive research has explored the role of social capital and gender in shaping the antecedents of EIs and the venture performance, the interplay between media, social capital, gender and EI and EB remains underexplored.

Thus, this study examined how media, social capital and gender impact EI and its antecedents. Additionally, the study explored the direct effects of media and social capital on EB, and the influence of EI and perceived behavioural control (PBC) on EB.

2. Theoretical Framework and Hypotheses

2.1 The Theory of Planned Behaviour (TPB)

Ajzen's (1991) TPB has been extensively applied in various fields to predict intention and human behaviour (EI) (Ajzen, 1991, Ilomo and Mwantimwa, 2023; Krueger et al., 2000). The theory suggests that the intention to perform any behaviour is influenced by attitude towards behaviour (ATB), PBC, and subjective norms (SN) (Ajzen, 1991). The theory postulates that an individual's intention to perform any behaviour is driven by their favourable evaluation of the behaviour, judgements of personal ability, and the perceived societal pressure to do so (Ajzen, 1991).

Most of previous studies provide full support for the TPB, indicating that EIs can be significantly explained by ATB, PBC, and SN (Mothibi and Malebana, 2019; Shahriar et al., 2024). However, in some studies, the TPB has been partially supported, demonstrating that EI can be significantly explained by ATB and PBC, but not SN (Blanco-Mesa et al., 2023; Duong, 2022; Ilomo and Mwantimwa, 2023). Studies by Amrouni and Azouaou (2024) and Kurniawan et al. (2024) reported the positive influence of SN on EI, but no effect of ATB or PBC. Therefore, it is hypothesised that:

H1: EIs of students are significantly influenced by their ATB.

H2: EIs of students are significantly influenced by their PBC.

H3: EIs of students are significantly influenced by their SN.

2.2 The Effect of Media on the Antecedents of Entrepreneurial Intention and Intention

According to Bandura (2001), media significantly shapes societal attitudes, beliefs, behavioural intentions, and actions. Mass communication channels, such as newspapers, TV, radio, and films, are major outlets that can influence a wide range of attitudes and behaviours, including entrepreneurial behaviour, among those exposed to them (Bandura, 2001; ul Haq et al., 2020). Therefore, positive portrayals of entrepreneurs in mass media and favourable discussions within society can significantly enhance EIs and their key antecedents (Adekiya & Ibrahim, 2016; Laguía and Moriano, 2021; ul Haq *et al.*, 2020).

Findings from previous research indicate the positive influence of the media on EIs and their key antecedents (Adekiya and Ibrahim, 2016; Aparicio et al., 2021; de Pillis and Reardon, 2007; Laguía and Moriano, 2021; Levie et al., 2010; Mothibi and Malebana, 2019; ul Haq *et al.*, 2020). Therefore, it is hypothesised that:

H4: Media significantly influences the ATB of students.

H5: Media significantly influences the PBC of students.

H6: Media significantly influences the SN of students.

H7: Media has a direct and significant influence the EI of students.

H8: Media has a direct and significant influence the EB of students.

2.3 The Effect of Social Capital on the Antecedents of Entrepreneurial Intention and Intention

Entrepreneurial activity is a socially embedded behaviour that is facilitated by social exchanges of various resources and support necessary for entrepreneurial ventures to succeed (Hassan et al., 2024 Burt, 2019). Social networks are deemed instrumental in generating and preserving social capital (Hassan et al., 2024; Malebana, 2016). Social capital refers to different tangible and intangible resources that can be accessed by individuals through their connections with others (Burt, 2019; Nahapiet and Ghoshal, 1998). It is suggested that individuals with broad and diverse social networks are more likely to access valuable resources, information, entrepreneurial role models, market opportunities, and support for starting a business (Hassan et al., 2024; Malebana, 2016; Fernández et al., 2021).

Previous research suggests that social capital plays a crucial role in shaping the antecedents of EI and EI (Doanh and Bernat, 2020; Fernández et al., 2021; Hassan et al., 2024; Malebana, 2016; Raevskaya and Tatarko, 2022). Therefore, the following hypotheses are formulated:

H9: Social capital significantly influences the ATB of students.

H10: Social capital significantly influences the PBC of students.

H11: Social capital significantly influences the SN of students.

H12: Social capital has a direct and significant influence the EI of students.

H13: Social capital has a direct and significant influence the EB of students.

2.4 The Effect of Gender on the Antecedents of Entrepreneurial Intention and Intention

Past research has found a positive association between gender and entrepreneurial intentions and participation in entrepreneurship (Ramírez-Salinas et al., 2024; Malebana and Vhukeya, 2023; Hill et al., 2024).

Earlier research shows that gender had varying effects on the antecedents of EI and EI (Gomes et al., 2021; Maes et al., 2014; Malebana, 2015; Santhanamery et al., 2022) and EI. Similarly, other studies found the positive influence of gender on ATB and PBC but not on SN (Gomes et al., 2021; Maes et al., 2014).

As a result, the following hypotheses are formulated:

H14: Gender significantly influences the ATB of students.

H15: Gender significantly influences the PBC of students.

H16: Gender significantly influences the SN of students.

2.5 The Effect of Entrepreneurial Intention and Perceived Behavioural Control on Entrepreneurial Behaviour

According to the TPB, behavioural intention and PBC are the two main factors that can directly influence any behaviour, including EB (Ajzen, 1991; Joensuu-Salo et al., 2020). EB refers to actions undertaken in starting and growing a new business (Ben-Hafaïedh and Ratinho, 2019; McAdam and Cunningham, 2019). The findings of some previous studies support Ajzen's (1991) assertion, indicating a positive association between EI and EB (Bouarir et al., 2023; Cui and Bell, 2022; Neneh and Dzomonda, 2024) and between PBC and EB (Kautonen et al., 2015; Nergui, 2020). In contrast, Joensuu-Salo et al. (2020) reported the effect of PBC on EB to be insignificant. It is thus evident from the findings that both EI and PBC play an important role in explaining EB. Thus, the following hypotheses are formulated:

H17: Students' EB is significantly influenced by their EI.

H18: Students' EB is significantly influenced by their PBC.

The hypothesised relationships are depicted in Figure 1 below.

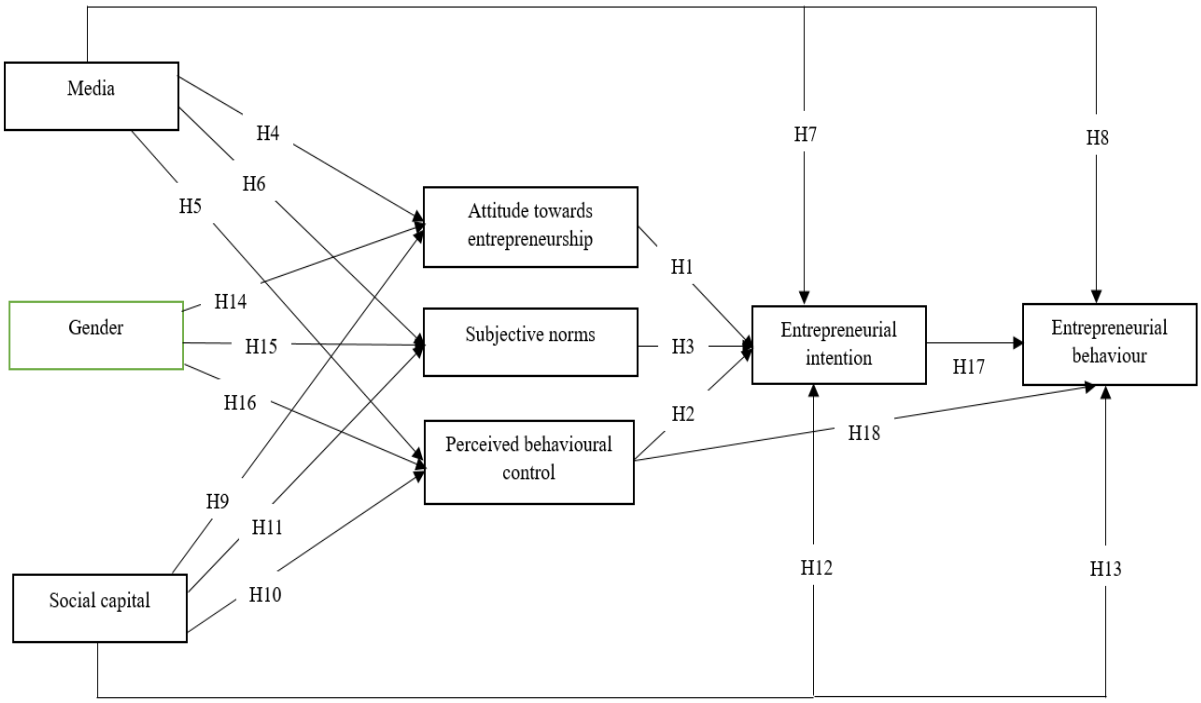


Figure 1: Conceptual Framework of the Study.

Source: Developed by the researchers.

3. Methodological Approach

3.1 Sample and Procedure

The study initially aimed to conduct a census of all 702 final-year diploma students from the Tshwane University of Technology (TUT) and Tshwane North TVET College, using institutional databases. As some students were not available, a convenience sampling approach was adopted. Consequently, a total of 496 final-year diploma students who were willing to participate were included in the study. Of these, 271 were from Tshwane North TVET College, while 225 were from TUT, as presented in Table 1. In terms of age distribution, most respondents (80.4%) fell within the 18-24 age group, followed by 18.2% aged 25-34, and 1.4% aged 35-44. Regarding gender representation, females constituted 59% of the sample, whereas males made up 41%.

Table 1: Demographic overview of respondents

Variables	Description	Frequency	Percentage (%)
Gender	Male	203	41
	Female	293	59
	Total	**496**	**100**
Age	18-24 years	399	80.4
	25-34 years	90	18.2
	35 years and above	7	1.4
	Total	**496**	**100**
Institution	Tshwane University of Technology (TUT)	225	45
	Tshwane North TVET College	271	55
	Total	**496**	**100**

Data collection was carried out following ethical approval from the Tshwane University of Technology Research Ethics Committee and the Department of Higher Education and Training. Participants were briefed on the study's purpose and invited to take part voluntarily, with full assurances of anonymity.

3.2 Data Collection Instrument

This study employed an online structured questionnaire, adapted from the Entrepreneurial Intention Questionnaires (EIQ) developed by Liñán and Chen (2009) and validated by Malebana (2012). For social capital, the study applied the measurement scales proposed by Liñán and Santos (2007), which were later validated by Malebana (2012, 2016). Questions relating to media perceptions were derived directly from the works of Levie et al. (2010) and Laguía and Moriano (2021), and were subsequently validated by Mothibi (2018). A five-point Likert scale (1=strongly disagree to 5=strongly agree) was employed to measure media perceptions, social capital, EI, and its antecedents. Nominal-type questions requiring "yes" or "no" responses were used for measuring EB based on a scale adapted from Kautonen et al., (2015).

4. Research Results

4.1 Analysis of the Measurement Model

Partial least squares structural equation modelling (PLS-SEM) based on SmartPLS4 software (version 4.0.8.3) was applied to evaluate the measurement model. Following Hair and Alamer's (2022) suggested threshold of 0.7, items with a factor loading below 0.5 were excluded from the model. As shown in Table 2, all factor loadings exceed the 0.5 threshold, with values ranging from 0.527 to 1.00, in line with Hair et al. (2019).

Cronbach's alpha (α) and composite reliability (CR) scores were checked to ensure the internal consistency reliability of the constructs. As shown in Table 2, the PLS-SEM results reveal that both Cronbach's alpha (α) were between 0.771 and 0.922 while composite reliability (CR) values were between 0.853 and 0.938 which exceed the 0.60 threshold, as suggested by Sarstedt et al. (2017). These findings show that the survey questions represented an accurate measure of the constructs in the study.

The Average Variance Extracted (AVE) for all items of the constructs were examined to ensure convergent validity. As presented in Table 2, the AVE values for all constructs exceeded the 0.50 threshold (Hair et al., 2019) and ranged between 0.553 and 0.706. These results demonstrate satisfactory convergent validity, confirming that each construct effectively captures the variance in its respective items.

Table 2: Reliability and convergent validity assessment

Constructs	Items	Factor loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Attitude towards the behaviour	ATB2	0.651	0.805	0.866	0.566
	ATB3	0.789			
	ATB4	0.792			
	ATB5	0.841			
	ATB6	0.670			
Social capital	SC10	0.750	0.882	0.907	0.553
	SC3	0.518			
	SC4	0.717			
	SC5	0.758			
	SC6	0.706			
	SC7	0.782			
	SC8	0.826			
	SC9	0.843			
Media	MD1	0.816	0.916	0.935	0.706
	MD2	0.747			
	MD3	0.863			
	MD4	0.894			
	MD5	0.900			
	MD6	0.811			

Constructs	Items	Factor loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Gender	GN	1.000	1.000	1.000	1.000
Perceived behavioural control	PBC1	0.692	0.844	0.885	0.561
	PBC2	0.765			
	PBC3	0.765			
	PBC4	0.743			
	PBC5	0.783			
	PBC6	0.742			
Entrepreneurial intention	EI1	0.783	0.922	0.938	0.682
	EI2	0.749			
	EI3	0.885			
	EI4	0.848			
	EI5	0.818			
	EI6	0.863			
	EI7	0.830			
Entrepreneurial behaviour	EB11	0.813			
	EB2	0.642	0.771	0.853	0.595
	EB8	0.849			
	EB9	0.765			

Fornell-Larcker criterion was used to evaluate discriminant validity. As indicated in Table 3, the AVE values were greater than all inter-construct correlations, further confirming the discriminant validity of each construct (Ab Hamid et al., 2017).

Table 3: Assessment of discriminant validity using the Fornell-Larcker criterion

	ATB	EB	EI	GN	MD	PBC	SC	SN
ATB	**0.752**							
EB	0.381	**0.771**						
EI	0.676	0.452	**0.826**					
GN	-0.129	-0.129	-0.153	**1.000**				
MD	0.419	0.358	0.488	-0.031	**0.840**			
PBC	0.615	0.480	0.707	-0.163	0.410	**0.749**		
SC	0.328	0.362	0.398	-0.126	0.532	0.426	**0.744**	
SN	0.463	0.140	0.341	-0.061	0.258	0.280	0.233	**0.782**

4.2 Analysis of the structural model

The structural model of the study was evaluated based on the coefficient of determination (R^2) to determine the model's explanatory power. Figure 2 indicates that the combined influence of MD, gender, and SC on ATB, SN, and PBC was 0.201, 0.080, and 0.243, respectively. This implies that MD, gender, and SC account for 20.1% of the variation in ATB, 8.0% in SN, and 24.3% in PBC. Further analysis reveals that the cumulative effect of MD, SC, ATB, SN, and PBC on EI is 0.616, signifying that these factors collectively account for 61.6% of the variation in EI. Lastly, the combined effect of MD, SC, EI, and PBC on EB is 0.286, which suggests that these factors explain 28.6% of the variation in EB.

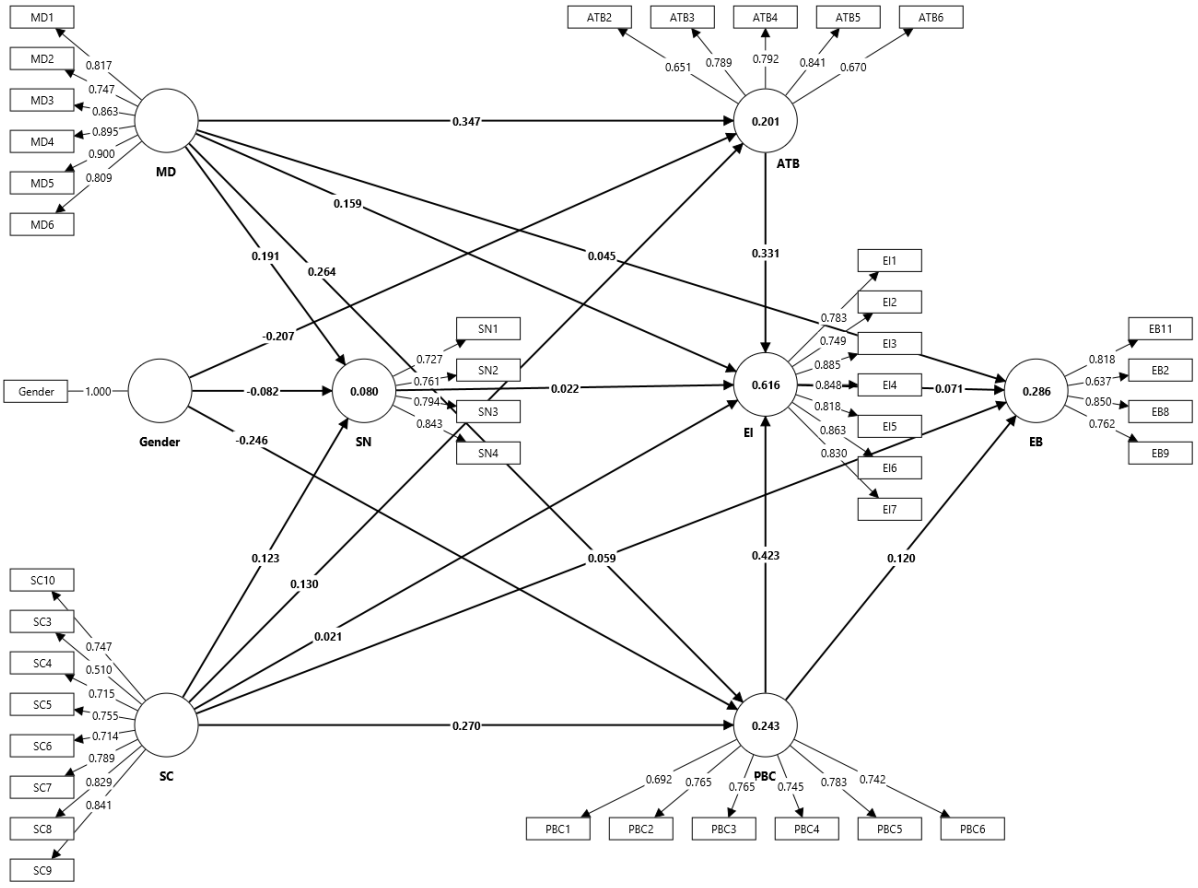


Figure 2: Results of the structural model analysis.

4.3 Assessment of Collinearity Issues

Collinearity was examined to prevent biased results. Since the VIF values were between 1.000 and 3.309, collinearity was not a significant concern and was therefore unlikely to affect the reliability of the findings (Hair et al., 2019).

4.4 Hypotheses Testing Results

The PLS-SEM results in Table 4 indicate that ATB ($\beta = 0.331$, $p < 0.000$) and PBC ($\beta = 0.423$, $p < 0.000$) were positively associated with EI, while SN was not ($\beta = 0.022$, $p < 0.520$). These findings support H1 and H2, while no support was found for H3.

MD was positively related to ATB ($\beta = 0.346$, $p < 0.000$), PBC ($\beta = 0.263$, $p < 0.000$), SN ($\beta = 0.189$, $p < 0.000$) and EI ($\beta = 0.159$, $p < 0.000$) but had no effect on EB ($\beta = 0.045$, $p < 0.077$). MD had the strongest effect on ATB, followed by its influence on PBC, and the least impact on SN. These results support H4, H5, H6 and H7.

Furthermore, findings revealed the positive influence of SC on ATB ($\beta = 0.132$, $p < 0.035$), PBC ($\beta = 0.271$, $p < 0.000$), SN ($\beta = 0.133$, $p < 0.038$) and EB ($\beta = 0.059$, $p < 0.015$) but not on EI ($\beta = 0.021$, $p = 0.594$). These findings H9, H10, H11 and H13 while H12 is rejected.

Gender was negatively related to both PBC ($\beta = -0.206$, $p < 0.017$) and ATB ($\beta = -0.245$, $p < 0.003$) but had no effect on SN ($\beta = -0.081$, $p = 0.384$). The findings provide support for H14 and H16, while no support was found for H15.

Additionally, both EI ($\beta = 0.100$, $p < 0.000$) and PBC ($\beta = 0.143$, $p < 0.000$) were positively related to EB, supporting H17 and H18.

Table 4: Path coefficients.

Path	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Significance level
ATB -> EI	0.331	0.330	0.065	5.078	0.000	***
PBC -> EI	0.423	0.423	0.057	7.460	0.000	***
SN -> EI	0.022	0.023	0.035	0.644	0.520	ns
MD -> ATB	0.346	0.346	0.056	6.216	0.000	***
MD -> PBC	0.263	0.263	0.055	4.770	0.000	***
MD -> SN	0.189	0.191	0.049	3.860	0.000	***
MD -> EB	0.045	0.044	0.025	1.768	0.077	ns
MD -> EI	0.159	0.159	0.043	3.691	0.000	***
SC -> ATB	0.132	0.132	0.062	2.108	0.035	*
SC -> PBC	0,271	0,272	0,061	4,455	0.000	***
SC -> SN	0.133	0.134	0.064	2.071	0.038	*
SC -> EB	0.059	0.061	0.024	2.424	0.015	**
SC -> EI	0.021	0.020	0.040	0.533	0.594	ns
Gender -> ATB	-0.206	-0.207	0.087	2.380	0.017	*
Gender -> PBC	-0.245	-0.247	0.083	2.953	0.003	**
Gender -> SN	-0.081	-0.085	0.093	0.871	0.384	ns
EI -> EB	0.100	0.099	0.026	3.906	0.000	***
PBC -> EB	0.143	0.144	0.025	5.684	0.000	***

*p < 0.05; **p < 0.01; ***p < 0.001 (levels of statistical significance).

5. Discussion of Findings

This study examined how social capital, media and gender influence the antecedents of EI among TVET college and university students. The study tested the impact of SC and MD on EI and EB, as well as the impact of EI and PBC on EB. Findings showed that MD is positively related to ATB, PBC and SN. These results concur with those of Levie et al. (2010) and Mothibi and Malebana (2019). However, the findings partially contradict those of Laguía and Moriano (2021) who found that MD had a positive influence on ATB and PBC but not on SN. These findings suggest that positive media content or reporting about entrepreneurship and entrepreneurs can stimulate EI by fostering favourable attitudes, boosting confidence in entrepreneurial capabilities, and strengthening the perception of societal support for entrepreneurial activities. Furthermore, the findings revealed that MD had a direct influence on EI. These results are in line with Adekiya and Ibrahim (2016); Aparicio et al. (2021) and de Pillis and Reardon (2007).

The results show that SC positively influences ATB, PBC and SN. These results corroborate those of Hassan et al. (2024). These findings suggest that SC can shape attitudes toward entrepreneurship, enhance one's perceived ability to start a business and increase perceived social pressure to start a business. However, the results do not align with those of Doanh and Bernat (2020) and Raevskaya and Tatarko (2022) who reported a nonsignificant relationship between SC and ATB, and Fernández et al. (2021) regarding the nonsignificant relationship between SC and PBC. SC did not have a direct relationship with EI. These findings align with those of Doanh and Bernat (2020), but contradict those of Hassan et al. (2024).

The findings showed the negative effect of gender on ATB and PBC, but no impact on SN. While the results were negative, they support those of previous studies that have shown that gender influences ATB and PBC, but not SN (Gomes et al., 2021; Maes et al., 2014). These findings suggest that gender significantly affects how people evaluate entrepreneurship and perceived PBC but has no significant effect on SN.

The findings of the study partially supported the TPB as a model for predicting EI of TVET college and university students. The results indicate that among the three antecedents, EI is significantly influenced by ATB and PBC, but not SN. These findings align with previous studies that also found ATB and PBC to have a positive influence on EI, while SN did not (Blanco-Mesa et al., 2023; Duong, 2022; Ilomo and Mwantimwa, 2023). These findings suggest that EI is determined more by favourable attitudes towards entrepreneurship and confidence in the ability to engage in entrepreneurship than societal expectations or the influence of others. However, the results of this study are in contrast with earlier research that found a statistically significant relationship between EI and SN, but not with ATB or PBC (Amrouni and Azouaou, 2024; Kurniawan et al., 2024).

Additionally, the results in this study have shown EI and PBC positively influence EB. These results corroborate previous studies on the positive influence of EI (Bouarir *et al.*, 2023; Cui and Bell, 2022; Neneh and Dzomonda, 2024) and PBC on EB (Kautonen et al., 2015; Nergui, 2020). These results suggest that, among TVET college and university students, a strong intention to pursue entrepreneurship and confidence in one's perceived ability are significant factors determining their actual entrepreneurial behaviour.

5.1 Implications

Policymakers and entrepreneurship educators should design and implement interventions that foster and support the development of EIs and facilitate their translation into EB. To achieve this, firstly, collaboration between the government and media houses is vital to promote entrepreneurship and cultivate an entrepreneurial culture in South Africa. The collaboration should result in the development of television programs highlighting the economic benefits of entrepreneurship and radio interviews with entrepreneurs portraying both successes and challenges in starting and managing a new business. Such initiatives would offer valuable insights into the entrepreneurial journey, and ultimately enhance positive entrepreneurial attitudes and boost PBC, and strengthen the perception of societal support for entrepreneurial activities among young people. Secondly, policymakers and entrepreneurship educators should collaborate to create and fund initiatives that build and strengthen social networks for aspiring entrepreneurs. These initiatives could include networking events, mentorship programs, and industry connections, providing students with valuable resources, advice, support, and opportunities to interact with local entrepreneurs and business leaders. This approach will help to foster positive ATB, enhance perceptions of social support, and boost students' PBC. Thirdly, the positive influence of PBC on EI and EB indicate the need to provide hands-on, practical, student-centred learning to enhance PBC. There is a need for targeted interventions to help enhance PBC and ATB among female students, which may include tailor-made financial and non-financial support and exposure to social networks for women entrepreneurs, and media programmes showcasing successful women entrepreneurs.

5.2 Conclusion, Limitations and Areas for Further Research

Entrepreneurial activity is essential for cultivating a dynamic economy with reduced unemployment rates. Therefore, concerted efforts are needed to understand the factors that drive new venture creation and performance. An understanding of the impact of these factors would help policymakers and entrepreneurship educators in designing targeted interventions that foster a supportive environment that enables aspiring entrepreneurs to convert their intentions into entrepreneurial actions.

The limitations of this study are the use of cross-sectional data, which provided a snapshot of variables at a specific point in time which precluded a longitudinal analysis. Additionally, the study was based on a convenience sample of TVET college and university students in Gauteng, limiting the generalisability of the findings to all TVET college and university students across South Africa. Future studies should consider conducting similar studies in other provinces and comparing results across different regions and participant types.

Ethics Declaration

Ethical clearance was obtained from the Tshwane University of Technology Research Ethics Committee.

AI Declaration

No AI tools were used in the creation of this paper.

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Epistemic Curiosity and Entrepreneurial Intentions: Insights from China's Emerging Ecosystem

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Abstract: Guided by Entrepreneurial Event Theory (EET), we analysed survey data from 179 engineering students at Xi'an Jiaotong-Liverpool University's Entrepreneur College (Taicang) to identify what drives entrepreneurial intention (EI). Interest in entrepreneurship and epistemic curiosity (EC) emerged as the strongest predictors, with EC partially mediating the pathway from both entrepreneurial interest and perceived organisational valuing of creativity (POVC) to EI. Counter-intuitively, higher family income predicted lower EI, challenging resource-based assumptions. The model explains 42.2% of the variance in EI, consistent with prior research. Findings suggest that entrepreneurship programmes should prioritise curiosity-driven, creativity-supportive learning environments and tailor support to students' socioeconomic backgrounds. By positioning EC as a cognitive catalyst and highlighting the nuanced role of income, the study extends EET and clarifies how demographic, attitudinal, and contextual factors interact within China's pro-innovation landscape.

Keywords: Epistemic Curiosity, Entrepreneurial Intention, Entrepreneurial Event Theory, Organizational Creativity, China

1. Introduction

Entrepreneurial intentions in China are shaped by the intersection of demographic, attitudinal, and environmental factors, unfolding within a fast-evolving innovation ecosystem (Gao et al., 2022; You et al., 2023). Chinese higher education institutions (HEIs) have prioritized entrepreneurship education since the early 2000s, with policy advancements in 2010 reshaping its integration into curricula. International research has established epistemic curiosity (EC) as a foundational driver of entrepreneurship education outcomes. EC is the innate drive to explore new ideas and solve problems. However, empirical exploration of its role in Chinese higher education institutions (HEIs) remains limited.

This study specifically focuses on understanding how epistemic curiosity (EC) can shape entrepreneurial intentions (EI), and how factors such as family income, perceived organizational valuing of creativity (POVC), and risk willingness interact with these variables to influence engineering students' entrepreneurial behaviours within a Chinese cultural context. The goal is to provide a more nuanced understanding of how these factors intertwine, which has implications for both policy and education.

Recent studies confirm that cognitive and attitudinal factors, for example, interest in entrepreneurship, willingness to take risks, curiosity, and creativity, have a significant influence on entrepreneurial intention (Niu et al., 2022; Fadzil et al., 2022). The interaction and impact of such factors on entrepreneurship outcomes remains ambiguous (Niu et al., 2022; Heredia-Carroza et al., 2024). Newer themes in the literature, including post-pandemic entrepreneurship (Yu et al.,2021), implications of digital technology (Ip, 2024) and cross-cultural dynamics (Dheer and Castrogiovanni,2023) make the demand for comprehensive models even more conspicuous. This research fills these gaps to address recommendations for better entrepreneurial ecosystems through an examination of the interrelationship between demographic variables and attitudinal factors within a Chinese cultural context.

2. Literature Review

2.1 Entrepreneurial Event Theory and Intention

Entrepreneurial Event Theory (EET) provides a foundation for analysing intent formation and the behaviours resulting from that entrepreneurial intention. EET identifies three critical components—perceived desirability, perceived feasibility, and the propensity to act—that influence entrepreneurial intention (Ambad & Rafiki, 2024). This study expands on EET by incorporating cognitive and attitudinal variables such as epistemic curiosity

(EC), the perceived organizational valuing of creativity (POVC), and the attitudes toward creative expression (ATEC), factors that interact with demographic variables to shape entrepreneurial intention (EI).

For Chinese university students, perceived desirability refers to their disposition toward entrepreneurship and interest in initiating businesses. It is influenced by entrepreneurial education and successful experiences. China's dynamic entrepreneurial ecosystem further amplifies the perceived desirability of making entrepreneurship a career choice (Zhang, 2024).

Perceived feasibility refers to a person's belief regarding the success of initiating and running a business. This is related to self-efficacy and also depends on educational preparation, skill acquisition, and support systems. Institutions that encourage creativity and innovation may increase students' perceived feasibility by equipping them with practical experience (Balgiu & Simionescu-Panait, 2024).

The propensity to act is closely linked to our variables of epistemic curiosity and willingness to take risks. Greater levels of epistemic curiosity among students make it more likely that they will seek and seize entrepreneurial opportunities. Similarly, higher levels of risk tolerance are associated with greater action in pursuing entrepreneurial intentions (Heinemann et al., 2022; Hsieh & Pittaway, 2024).

A recent study by Yu et al. (2021) further extends EET by adding the dimensions of creativity and innovation. The study revealed that an individual's attitude toward creative expression and perception of organizational support for creativity significantly influences the desirability and feasibility dimensions. This extension fits closely with our examination of the relationships through which perceived organizational valuation of creativity (POVC) affects entrepreneurial intentions-generating changes in attitudes.

China’s cultural norms and pro-entrepreneurial policies create a supportive context for new ventures (Komninos et al., 2024; Gao et al., 2022; You et al., 2023; Zhang, 2024). Yet, relatively little is understood about how demographic factors and attitudes interact to shape entrepreneurial intentions (Yu et al., 2021; Heredia-Carroza et al., 2024). Cultural values and government policies create a favourable environment for entrepreneurship in China, emphasising competence and diligence (Zhou & Li, 2022; Dai, 2021; Joshi et al., 2020).

2.2 Entrepreneurial Intention and Key Factors

Entrepreneurial capacity rests on self-efficacy, creative thinking and basic managerial skills (Kisubi et al., 2021). Experiential courses, from business simulations to hackathons, have been shown to strengthen both self-belief and risk willingness, thereby raising perceived behavioural control (Mensah et al., 2021; Djazilan & Darmawan, 2022; Duan, 2022; Zhou & Li, 2022; Khanal & Prajapati, 2023).

- **Interest in starting a business:** Entrepreneurial interest grows through curiosity, peer encouragement and visible role models (Niu et al., 2022; Anjum et al., 2020). Campus demo days and alumni success stories help to keep that interest active (Surutra et al., 2021; Duong, 2023).
- **Willingness to Take Risks:** Risk tolerance is linked to innovation and proactive decision making (Fadzil et al., 2022; Lone & Baba, 2023). Educational settings that normalise “learning from failure” translate this tolerance into stronger start-up intentions (Duong, 2023; Salleh et al., 2024).
- **Epistemic Curiosity:** EC is the urge to understand how things work. It helps students identify market gaps, master new technologies and stay calm amid uncertainty. Higher EC aligns closely with entrepreneurial inclination (Balgiu & Simionescu-Panait, 2024; Heinemann et al., 2022; Hsieh & Pittaway, 2024).
- **Attitude towards Creativity***:* Positive attitude*s* toward*s* creativity (ATEC) are direct predictor*s* of entrepreneurial intention (Anjum et al., 2020; Fadzil et al., 2022; Balgiu & Simionescu-Panait, 2024). ATEC is the most relevant sub-dimension in China’s innovation-driven context, because organisational support channels through creativity before it influences intention. Creative learning environments amplify this pathway (Mahendiren & Kushwaha, 2024; Mutlu & Çoruk, 2024).
- **Perceived Organizational Valuing of Creativity (POVC)**: When students believe that novel ideas are welcomed, psychological safety rises, experimentation follows and entrepreneurial intention increases (Anjum et al., 2020; Balgiu & Simionescu-Panait, 2024). The effect is strongest where committed teaching and adequate resources meet (Mutlu & Çoruk, 2024).
- **Demographic and Contextual Factors in Shaping Entrepreneurial Intention:** Education shapes the foregoing relationships. Experiential learning strengthens the creativity-risk-intention chain (Fadzil et al., 2022). Contextual variables frequently mediate or moderate the creativity-intention pathway (Niu et al., 2022).

2.3 Research Gaps and Justification for the Study

Scholars still treat the "who," "what," and "where" of entrepreneurial intention as separate puzzles. Demographic work tends to isolate socioeconomic status (Khanal & Prajapati 2023; Heredia-Carroza et al. 2024), while psychological work singles out risk-taking, creativity, or curiosity (Yu et al. 2021; Fadzil et al. 2022). Little is known about how family income sparks intention. In addition, classic lenses such as the Theory of Planned Behaviour (Ajzen 1991; Ambad & Rafiki 2024) rarely test interaction effects or compare sub-groups.

We tackle these gaps by modelling how income mesh with risk willingness, climate creativity, and epistemic curiosity among Chinese undergraduates. The mixed picture that emerges should guide campus incubators and innovation policymakers, offering evidence that is China-specific yet instructive for other growth economies (Gao et al. 2022; You et al. 2023).

To enhance the study's alignment with contemporary discourse, we acknowledge recent shifts in entrepreneurial intention driven by digital transformation and post-pandemic dynamics. The COVID-19 pandemic has redefined risk perceptions and opportunity structures, with many students now perceiving entrepreneurship as a resilient career option (Yu et al., 2021). Research shows that digital readiness can amplify the effects of epistemic curiosity on entrepreneurial outcomes, especially when paired with institutional creativity support (Ip, 2024).

2.4 Theoretical Framework and Hypotheses

Entrepreneurial Event Theory (EET) argues that intention grows from perceived desirability, perceived feasibility and a readiness to act (Shapero & Sokol 1982; Ambad & Rafiki 2024). We extend EET by adding two cognitive–contextual levers: epistemic curiosity (EC) and perceived organisational valuing of creativity (POVC).

Epistemic curiosity is the drive to seek new information. It amplifies desirability because curious students spot attractive gaps, then turn that heightened interest into intention.

POVC signals psychological safety and resources for experimentation. It strengthens feasibility; students who believe novel ideas are welcomed feel bolder about acting.

EC and POVC complement EET elements, showing how inner motives and campus climate jointly propel entrepreneurial intention (EI).

POVC also shapes attitudes toward creativity (ATEC). A supportive setting tools, funds and rewards creative thought; receptive students in turn channel that positive attitude into stronger EI (Balgiu & Simionescu-Panait 2024; Mahendiren & Kushwaha 2024).

EC mediates the path from interest in entrepreneurship (IIE) to EI: curiosity triggers deeper exploration, reduces uncertainty and nudges interest into commitment (Heinemann et al. 2022). Likewise, EC mediates the POVC-ATEC link, including the EC → ATEC path: a creativity-friendly culture sparks curiosity; that curiosity then converts supportive signals into a pro-creativity attitude, which finally lifts EI (Hsieh & Pittaway 2024). This twin-mediation model captures the dynamic interplay of cognition (curiosity), climate (POVC) and attitude (ATEC) inside EET, offering a sharper lens for China's innovation-driven universities.

Drawing on our extended EET model, we propose seven hypotheses, grounded in prior research and tailored to China's innovation-driven university context, that link cognitive motives, creative climate, and contextual conditions to entrepreneurial intention, as summarised in the following table.

The following figure 1 overlays all seven hypotheses on a single path diagram, highlighting direct and mediated routes (solid and dashed arrows, respectively) and situating EC as the pivotal cognitive conduit.

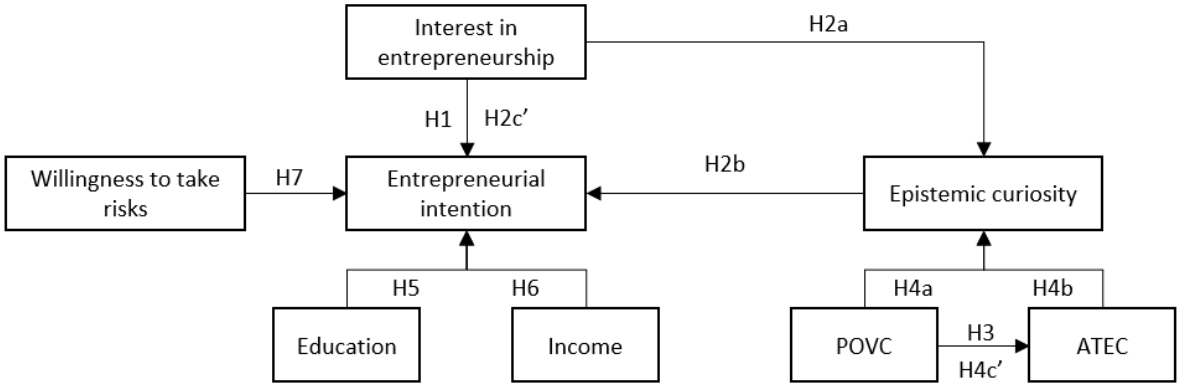


Figure 1: Integrated model

The following section details the survey design, measurement scales, and analytical procedures used in this study.

3. Methodology

A purposive sampling technique targeted the Year 4 engineering students at the Entrepreneur College (Taicang), Xi'an Jiaotong-Liverpool University, before they got enrolled in the ENT302TC Cutting-Edge Practice in Innovation and Entrepreneurship class. The intention was to determine the entrepreneurial intentions and attitudes of students prior to their formal engagement with entrepreneurship education. The online questionnaire was disseminated to all eligible Year 4 students (N=248) through SurveyMonkey, resulting in 179 valid responses or a 72.2% response rate. To avoid any selection bias, anonymity and confidentiality of responses were assured; participation was voluntary. Sample demographics were representative of the broader student body (42.5% female vs. 57.5% male) and age cohort (65.4% are under 22 years).

The survey measures the direct and indirect relationships between variables, including how epistemic curiosity mediates the relationship between entrepreneurial interest (IIE) and entrepreneurial intention (EI), as well as how perceived organizational valuing of creativity (POVC) influences attitude toward creativity (ATEC). These interactions were tested through regression models and mediation analysis to uncover the underlying mechanisms driving entrepreneurial intention.

Established scales were used for measurement: entrepreneurial interest (Liñán & Chen, 2009), entrepreneurial intention (Solesvik et al., 2012), epistemic curiosity (Litman, 2008). Content and construct validity were confirmed through factor analysis (loadings > 0.7), with acceptable discriminant and convergent validity (inter-construct correlations < 0.85; AVE > 0.5) and strong reliability (Cronbach's $\alpha > 0.80$).

While self-reported data is a known limitation, steps were taken to mitigate potential biases and anonymity was assured to minimise social desirability bias.

We conducted exploratory data analysis to examine variable distributions and relationships before moving on to hypothesis testing. We then performed multiple linear regression analyses to test how the demographic, attitudinal, and contextual variables predict entrepreneurial intention. Standard diagnostic checks (for multicollinearity, normality, etc.) and a ten-fold cross-validation were conducted to ensure the model's robustness.

4. Results

Epistemic curiosity (EC) emerged as a pivotal conduit between entrepreneurial interest (IIE) and intention (EI), underlining how curiosity converts intrigue into action. Contrary to resource-based expectations, higher family income was associated with lower EI, implying that financial security may dull start-up urgency.

Interest in entrepreneurship (IIE) is strongly tied to entrepreneurial intention (EI, r = 0.659), while epistemic curiosity (EC) aligns closely with attitude toward entrepreneurial creativity (ATEC, r = 0.688). IIE shows a moderate link with perceived organisational valuing of creativity (POVC, r = 0.387), mirrored by POVC's association with EI (r = 0.310). Risk willingness (WTR) correlates negatively with both EC (-0.272) and EI (-0.250), hinting that bolder students may rely less on curiosity.

Hierarchical OLS shows that higher family income suppresses EI (β_high = -0.64, p < .001; β_mid = -0.14, ns), overturning resource-based assumptions. IIE (β = 0.50, p < .001) and EC (β = 0.31, p < .001) are the only positive predictors; other controls are non-significant. Model checks are satisfactory: intercept = 0.741; Shapiro–Wilk W = 0.982 (minor non-normality); homoscedastic residuals; all VIFs < 5. Ten-fold cross-validation confirms stability (RMSE = 0.422; MAE = 0.585; R^2 = 0.422).

Scales are internally consistent (α_EI = 0.954, α_EC = 0.887, α_POVC = 0.884, α_ATEC = 0.838; demographics α = 0.555). EC partially channels the IIE - EI path (ACME ≈ 0.08, p < .05; ADE ≈ 0.55), accounting for 12 % of the total effect. EC fully conveys the POVC - ATEC route (ACME ≈ 0.20; ADE ≈ 0.03), mediating 87 % of the impact—evidence that curiosity, not institutional cheer-leading alone, shapes creative attitudes.

4.1 Hypothesis Support

Table 1: Hypothesis Results, EET anchor and core citations

Hypothesis	Description	Result	Evidence	EET Anchor	Core Citations	
H1	Interest in entrepreneurship positively influences EI	Supported	*r* = 0.659, β = 0.50, *p* < .001	Desirability	Niu 2022; Anjum et al 2020	
H2	EC mediates IIE → EI	Partially Supported	ACME = 0.0789, *p* = 0.02	Desirability	Heinemann 2022; Hsieh 2024	
H3	POVC positively influences ATEC	Supported	*r* = 0.343, *p* < .001	Feasibility	Anjum et al 2020; Mutlu 2024	
H4	EC mediates POVC → ATEC	Supported	ACME = 0.2008, *p* < .001	Feasibility	Balgiu 2024; Hsieh 2024	
H5	Educational level positively influences EI	Not Supported	Non-significant	Feasibility	Duong 2023; Fadzil 2022	
H6	Family income influences EI	Rejected	β = -0.64, *p* < .001 (negative relationship)	Feasibility	Staniewski 2023; Saputra 2021	
H7	Risk willingness positively influences EI	Not Supported	*r* = -0.25, *p* < .05 (negative relationship)	Propensity to act	Fadzil 2022; Duong 2023	

The Table 1 above summarizes the statistical analysis, providing the EET anchors and the core citations for each. Interest in entrepreneurship (H1) is a robust driver of entrepreneurial intention, with epistemic curiosity (H2) acting as a significant mediator. Curiosity fully transmits the effect of perceived organisational valuing of creativity on attitudes toward creativity (H4), while both components of the mediation —POVC to EC and EC to ATEC —remain significant, underscoring the twin importance of institutional support and individual curiosity in shaping creative attitudes.

By contrast, educational level (H5) shows no direct influence on intention. Family income (H6) relates inversely to intention, challenging resource-based assumptions, and risk willingness (H7) exhibits a weak negative link, hinting at a more nuanced risk–intention dynamic.

Overall, the pattern confirms that curiosity and entrepreneurial interest dominate motivational pathways, while demographic and personality factors play subtler, sometimes counter-intuitive roles.

5. Discussion

Our findings indicate that epistemic curiosity significantly mediates the effect of entrepreneurial interest on intention, underlining that curiosity can transform initial interest into actionable commitment. Just as importantly, we found that higher family income was negatively associated with entrepreneurial intention, an unexpected and powerful result that challenges conventional, resource-based assumptions. Rather than enabling entrepreneurship, financial security may actually reduce the perceived urgency to pursue it. This dynamic aligns with the concept of “necessity entrepreneurship” (Duong, 2023; Salleh et al., 2024), where

limited resources drive individuals to seek income-generating opportunities. It also extends EET by revealing how socioeconomic status can reshape both desirability and feasibility perceptions. Students with economic security may regard entrepreneurship as optional or aspirational, while those from lower-income backgrounds may treat it as a pragmatic route to upward mobility. These insights suggest that entrepreneurship education must be responsive to such divergence: for higher-income students, reframing entrepreneurship as a path to innovation and societal impact may rekindle intention; for those with fewer resources, practical support and targeted programming can help lower barriers to entry and boost confidence.

Entrepreneurial interest (IIE) and epistemic curiosity (EC) were the strongest predictors of entrepreneurial intention. EC also partially mediated interest's effect, acting as a cognitive bridge that turns initial enthusiasm into planned action. This suggests that while interest sparks intention, curiosity sustains it. For educators, nurturing curiosity, not just stimulating interest, is key to fostering meaningful entrepreneurial commitment.

Surprisingly, risk willingness did not positively predict entrepreneurial intention in our data. In fact, it was negatively associated with EI. In the Chinese cultural context, this makes sense: students often prioritise stability and social harmony over bold risk-taking (Elshaer & Sobaih, 2023). High risk tolerance is not a universally lauded trait here as it might be in Western contexts. This cultural nuance suggests that promoting entrepreneurship in collectivist settings might require emphasising calculated, "safe" innovation (within incubators) rather than romanticising risk.

Our regression model explained ~42% of the variance in EI, aligning with prior studies and indicating a respectable level of explanatory power. This leaves room for other influences (e.g., macroeconomic factors) beyond our current scope, which could be explored in future research.

5.1 Synthesis: Epistemic Curiosity as a Cognitive Catalyst

Our findings reinforce and refine existing theory. Within the EET paradigm (which emphasizes desirability, feasibility, and propensity to act), we show that epistemic curiosity is a pivotal catalyst in converting entrepreneurial interest into intention – not a mere side factor, but a core mechanism that drives exploration and commitment. This extends traditional models by inserting a cognitive dimension (curiosity) into the interest - intention transition, highlighting that desirability alone isn't enough without the curiosity to explore and reduce uncertainty.

One way in which the inclusion of EC enhances our conceptual framework is by providing a more dynamic view of the interest component in the classical model. Where this traditionally sees interest as a stable antecedent to intention, our formulation reframes it as a curiosity-driven pursuit of insight that energizes and transforms interest. Specifically, curiosity sharpens opportunity awareness, reduces uncertainty through inquiry, and activates creative problem-solving, helping interest mature into actionable entrepreneurial intention.

Fostering curiosity alongside interest produces the strongest entrepreneurial intentions. This implies that educators and policymakers should create learning environments that spark students' curiosity; e.g., through inquiry-based projects, hackathons, or problem-based learning – rather than focusing solely on traditional business skill training. This means educators should use inquiry-based and creative learning methods rather than only teaching business skills.

By embedding epistemic curiosity into the entrepreneurial intention model, our study provides a more nuanced view of how cognitive factors interplay with motivation. This enriched perspective on EET can guide more effective intervention strategies (such as curriculum designs that actively cultivate curiosity) to boost entrepreneurial intentions among students.

5.2 Theoretical and Practical Implications

This study refines EET by identifying epistemic curiosity (EC) as a cognitive mechanism that transforms entrepreneurial interest into intention, deepening our understanding of perceived feasibility and desirability. The inverse link between family income and intention challenges resource-based assumptions, suggesting a more complex role for socioeconomic status in emerging economies. Finally, the interaction of personal traits with demographic context highlights that entrepreneurial intention emerges through dynamic interplay, not linear causation.

Our findings highlight three education and policy takeaways. One, since epistemic curiosity strongly predicts entrepreneurial intention, programmes should prioritise curiosity-driven learning using exploration, creative

inquiry, and open-ended tasks, not just technical instruction. Two, the inverse income-intention link shows wealthier students may need purpose and impact framing, while lower-income students require practical support and access. Three, generic programmes are less effective, so targeted approaches based on socioeconomic background are essential to nurture intention.

The link between POVC and entrepreneurial intention via EC suggests institutions should foster curiosity and creativity by redesigning curricula, assessments, and support systems to promote experimentation and innovation in entrepreneurship.

Policymakers should strengthen the entrepreneurial ecosystem by aligning incentives with curiosity-driven, innovation-led ventures. This includes offering grants or startup competitions, funding university-linked incubators, and recognising student ventures for academic credit. By embedding curiosity and experimentation into policy, policymakers can help translate student interest into real-world entrepreneurship.

Although the study discusses general implications, more actionable recommendations can help translate findings into practice. For policymakers, our findings suggest that promoting entrepreneurship in China requires not only funding and infrastructure but also policies that incentivize curiosity-driven learning. For example, grants that support student-led experiments or open-ended startup competitions can encourage deeper engagement. Educators, particularly in STEM fields, should embed curiosity-inducing activities such as hackathons, problem-based learning, and industry-sponsored challenges into the curriculum. Importantly, our findings imply that a one-size-fits-all approach is insufficient—support mechanisms must be tailored to students' socioeconomic backgrounds (Salleh et al., 2024; Duong, 2023).

5.3 Limitations and Future Research

All data were self-reported. Using self-reported data comes with known limitations, especially the risk that participants may respond in ways they think are expected rather than reflect their true views. In our context, where entrepreneurship is actively promoted by the university and broader policy landscape, some students may have overstated their interest or confidence in becoming entrepreneurs. This could have inflated some of the observed relationships. To reduce such bias, we took steps to ensure anonymity and made clear that responses would have no academic consequences. We relied on validated measurement tools and ran robustness checks—including cross-validation and diagnostics—to confirm the patterns were not artifacts of random variation or overfitting.

The sample comes from a single entrepreneurship-focused university, which may limit generalisability to other institutions or regions. Finally, while our model explained a meaningful portion of variance in entrepreneurial intention ($R^2 \approx 0.42$), unexplained variance remains, suggesting that additional variables beyond those studied here may also shape students' entrepreneurial intentions.

This study highlights several possible avenues for further investigation. Longitudinal research would more appropriately establish cause effects between epistemic curiosity and entrepreneurial intention, particularly tracking how these relate change across different stages of entrepreneurial development. Additionally, cross-institutional research could verify whether the findings in this study regarding socioeconomic status and entrepreneurial intention are applicable in other university contexts and regions within China.

6. Conclusion

This study explored how demographic and attitudinal factors shape entrepreneurial intentions among engineering students in China. Epistemic curiosity emerged as a cognitive catalyst, mediating the relationship between entrepreneurial interest and intention. At the same time, higher family income was negatively associated with entrepreneurial intention, challenging resource-based assumptions. These findings refine Entrepreneurial Event Theory (EET) by showing that cognitive dispositions and socioeconomic context both play a critical role in shaping entrepreneurial motivation. In practical terms, the study suggests that educators should tailor strategies to students' backgrounds. Those with fewer resources may benefit from direct support and encouragement to reduce barriers to entry, while for wealthier students, entrepreneurship may need to be reframed as a vehicle for innovation and societal contribution. Alongside traditional business training, entrepreneurship education should more deliberately cultivate epistemic curiosity through inquiry-led learning, open-ended tasks, and creative exploration.

Future research could investigate whether these patterns hold across other institutional or regional contexts within China and in international settings. Comparative studies may help clarify how cultural and economic environments mediate the relationship between curiosity, income, and intention. Longitudinal or experimental research could also assess whether targeted interventions to develop epistemic curiosity lead to stronger entrepreneurial commitment over time. By integrating curiosity more fully into both theoretical frameworks and pedagogical strategies, this study lays a foundation for more inclusive and effective entrepreneurship education.

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Ethical Approval

This study forms part of a larger ethically approved project funded by Xi'an Jiaotong-Liverpool University RDF-22-02-072, approval ER-UEC-110000486202305291811 40. All procedures followed the ethical standards of the broader research.

AI Statement

This manuscript was written by the authors. AI was used only for language refinements.

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The Role of Resilience and Theory of Planned Behavior Components in Shaping Entrepreneurial Intentions: A Study Among Business Students at IPS

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Abstract: Entrepreneurial intention (EI) is shaped by a combination of cognitive and psychological factors. This study investigates how resilience and the three components of the Theory of Planned Behavior (TPB) – Personal Attitudes (PA), Subjective Norms (SN), and Perceived Behavioral Control (PBC) – influence EI among undergraduate business students at the Polytechnic Institute of Setúbal (IPS). A quantitative approach was employed, using a structured questionnaire that combined the Entrepreneurial Intention Scale developed by Liñán and Chen (2009) with the Resilience Scale proposed by Campbell-Sills and Stein (2007). Data from 128 students were analyzed using factor analysis to confirm construct validity, followed by linear regression to test the proposed hypotheses. The results demonstrate that PA and PBC are strong positive predictors of EI, while SN has a weaker, though still significant, effect. Additionally, resilience shows a moderate but significant positive impact on EI, supporting its role as a relevant psychological contributor to entrepreneurial motivation. These findings reinforce the validity of the TPB framework while highlighting the added value of resilience. The study suggests that entrepreneurship education should not only address cognitive determinants but also integrate strategies that foster students' psychological adaptability to better prepare them for entrepreneurial challenges.

Keywords: Entrepreneurship, Entrepreneurial Intentions, Resilience, Entrepreneurship Education, Higher Education

1. Introduction

Entrepreneurship is widely recognized as a promising path for individuals to achieve financial independence while simultaneously contributing to economic development through job creation, innovation, competitiveness and economic growth (Barba-Sánchez et al., 2022). In this context, higher education institutions (HEIs) have increasingly promoted entrepreneurship education, viewing students as the entrepreneurs of tomorrow. This trend is supported by a growing body of research that identifies entrepreneurial intention (EI) as one of the most reliable predictors of entrepreneurial behavior (Bordean et al., 2025; Yu et al., 2021).

Understanding the factors that shape students' EI is therefore critical to nurturing future entrepreneurial aspirations. A range of cognitive and personality-related factors have been found to significantly influence students' intentions to engage in entrepreneurial activities (Biswas & Verma, 2021; Xanthopoulou & Sahinidis, 2024). On the other hand, social and environmental researchers have identified elements such as previous experiences, family background, regional culture, and government support as pivotal factors that shape the EI of students (Ali et al., 2019; Tiwari et al., 2020).

The argument that entrepreneurship can be stimulated and developed through education has gained growing recognition both within and outside the academic world. A substantial number of studies have examined the influence of entrepreneurship education on EI, and their findings are difficult to ignore. Given the central role of entrepreneurship in driving socio-economic development, there is increasing attention among policymakers, educators, and researchers toward entrepreneurship education as a strategic lever for national development (Nowiński et al., 2019). HEIs play an essential role in this process by equipping students with foundational entrepreneurial knowledge, as well as cognitive and non-cognitive skills that foster entrepreneurial engagement (Brüne & Lutz, 2020; Ncanywa & Dyantyi, 2022). This process not only motivates students to pursue entrepreneurial paths but also improves the overall quality of entrepreneurial ventures and increases the likelihood of success (Galloway & Brown 2002).

Entrepreneurship education has become a prominent feature in higher education curricula, not only in business schools but across a wide range of academic disciplines (Ncanywa & Dyantyi, 2022). Moreover, it should be

noted that the teaching of entrepreneurship is not only carried out in HEIs, since in last year's there has been a focus on teaching entrepreneurship both in high school, as well as in middle and elementary school.

This study seeks to explore the influence of resilience on EI, focusing on business students in higher education. By integrating resilience into the analysis of EI, this research aims to provide a more comprehensive understanding of the psychological foundations that support entrepreneurial aspirations.

The central research question guiding this work is: To what extent does resilience influence the EI of business students in higher education?

2. Literature Review

2.1 Entrepreneurial Intention

EI is widely recognized as a fundamental precursor to entrepreneurial behavior and is considered one of the most reliable predictors of human action (Aamir et al., 2021). According to Ajzen (1991) and Sutton (1998), most socially relevant behaviors fall under volitional control, meaning that individuals act based on conscious decisions. Intention thus represents the immediate antecedent of behavior, reflecting both the individual's willingness to engage in an activity and the effort they are prepared to invest to carry it out (Kim & James, 2016).

Over last decades, EI has attracted significant academic attention due to its crucial role in fostering entrepreneurship and, consequently, in supporting national development (Barba-Sánchez et al., 2022; Virasa et al., 2022). Literature identifies a wide range of factors that influence EI, including entrepreneurship education (Thomas, 2023; Xu et al., 2023), personality traits (Kent et al., 2022), perceived ability (Sedeh et al., 2021), and teaching and training (Chaker & Dellagi, 2023).

Beyond individual characteristics, external contextual factors also play a pivotal role in shaping EI. The social, political, and economic environment can create enabling or constraining conditions for entrepreneurship (Doanh, 2021). Public policies such as financial incentives, tax policies, and entrepreneurship support programs are often used by governments to reduce market failures and stimulate entrepreneurial activity (Owen & Vedanthachari, 2023). At the local level, resources such as financial capital (Sabri et al., 2023), support infrastructures (Bazan, 2022), and human capital (Luo et al., 2022) have been identified as key contributors to the development of EI.

Research also highlights the influence of family background and exposure to entrepreneurial environments. Studies by Carr and Sequeira (2007) and Wang et al. (2018) show that exposure to the family businesses has a significant intergenerational effect on EI. Family-related factors can influence opportunity recognition, decision-making regarding business creation, and the mobilization of necessary resources (Zaman et al., 2021). Both direct exposure to entrepreneurship and symbolic family influence are linked to increased EI. Students with such backgrounds tend to exhibit higher EI, often accompanied by greater qualifications or prior self-employment experience (Mónico et al., 2021).

Moreover, empirical studies have revealed a persistent gender disparity in EI and motivation, with male students generally demonstrating higher levels of EI compared to their female counterparts (Villasana et al., 2016). These disparities are often attributed to differences in perceived behavioral control, social expectations, and access to entrepreneurial networks and resources.

Considering these findings, recent research has increasingly highlighted the importance of fostering an entrepreneurial mindset and intention as precursors to entrepreneurial behavior (Cui & Bell, 2022). These elements can be significantly shaped by entrepreneurship education, which plays a crucial role in developing both cognitive and attitudinal competencies conducive to entrepreneurship.

2.2 Theory of Planned Behavior

The Theory of Planned Behavior (TPB), developed by Ajzen (1988, 1991) and rooted in the Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975), has become one of the most widely adopted psychological models for explaining and predicting human behavior (Carr & Sequeira, 2007; Kolvereid, 1996a; Maheshwari & Kha, 2021; Romero-Colmenares & Reyes-Rodríguez, 2022). Within the field of entrepreneurship, the TPB has proven particularly useful in explaining the emergence of EI (Liñán & Chen, 2009; Sampene et al., 2022).

Validated across various domains, the TPB offers a robust framework for understanding how individuals form intentions to act. In the entrepreneurial context, the theory posits that EI is a planned, volitional behavior (Bird, 1988), and therefore represents a reliable predictor of future entrepreneurial action (Fayolle et al., 2006).

Ajzen (1991) defines intentions as “indicators of the difficulty that individuals are willing to try, of how much effort they are willing to exert, to execute the behavior”. The stronger the intention to act, the more likely it is that the behavior will be performed. Accordingly, intention is considered the immediate antecedent of behavior (Ajzen, 1991, 2002).

The TPB postulates that intentions have three conceptually independent determinants (“antecedents of intentions”), namely, Personal Attitudes (PA), Subjective Norms (SN) and Perceived Behavioral Control (PBC) (Ajzen, 1991). PA refers to the degree to which a person has a favorable or unfavorable evaluation or appreciation of the behavior in question. The term SN refers to the perceived social pressure to perform or not perform that behavior. As for PBC, this refers to the perceived ease or difficulty of carrying out the behavior.

Ajzen and Fishbein (2004) note that while all three antecedents contribute to predicting intention, their relative importance may vary depending on the context. In some cases, one or two may suffice to explain behavioral intentions.

Empirical studies have validated this structure in entrepreneurial contexts. For example, Barba-Sánchez et al. (2022) found that PA and PBC had a direct impact on students' EI, whereas SN played a more indirect role, acting as a mediator between environmental awareness and the other two constructs.

Importantly, the TPB does not assume that demographic or background variables directly influence intentions. Instead, these variables are expected to exert their influence indirectly, through their effects on PA, SN and PBC (Kolvereid, 1996b). This distinction reinforces the theory’s cognitive and motivational focus, highlighting the mediating role of individual perceptions in shaping EI.

Given its empirical robustness and conceptual clarity, the TPB offers a solid foundation for modeling EI. In the present study, its three components – PA, SN, and PBC – are considered as primary cognitive antecedents of EI.

2.3 Resilience

Nowadays "resilience" is extensively used in several scientific areas, namely psychology, medicine, and social sciences and is usually referred to the impact on a person of adverse (extreme, threatening, stressful) conditions and the ability to maintain normal performance of a person during and after such an impact (Grygorenko & Naydonova, 2023).

Many researchers state that the negative impact of stress or psychological trauma precedes resilience, and they agree that resilience belongs to the category of positive adaptation and adjustment (Ten Hove & Rosenbaum, 2018).

Most studies emphasize that resilience is a process. This shift in understanding stems from a gradual transition over the years – from viewing resilience as a personal trait to seeing it as a dynamic, developing process (Ten Hove & Rosenbaum, 2018; Stainton et al., 2018). As a result, there is now a consensus in the scientific community that resilience is not static but inherently dynamic in nature (Stainton et al., 2018).

Contextualizing resilience in business and entrepreneurship Manzano and Ayala (2013) refers to resilience as an important factor that becomes a fundamental source and expertise for entrepreneurs so that the business is run successfully. According to these authors, if a person has resilience, he/she will use this attribute to overcome the physical and psychological demands that must be faced later when adapting to change. Consequently, resilience is a critical factor for those with high EI.

Earlier research discusses how EI and resilience influence entrepreneurial behavior. According to Rohanara (2023), the effect of EI and resilience on entrepreneurial behavior in the millennial generation indicate that college students have scores of EI and higher resilience than employees, because they have taken courses which provide them with training on entrepreneurship.

Several authors agree that there is a relationship between resilience and EI and some of them have considered TPB and its effect on resilience (e.g., Silva et al., 2019). Some authors link attitude to variables such as risk, suggesting a connection with resilience (González-López et al., 2018); others highlight family roles and social support as key to resilience in the entrepreneurial process (Bernar & Barbosa, 2016) and some view perceived control as the ability to face challenges (Margaca et al., 2021).

3. Study Model and Hypothesis

Based on the literature reviewed above, the following hypotheses are proposed as part of this study and are illustrated in Figure 1.

H1: PA have a positive impact on EI

H2: SN have a positive impact on EI

H3: PBC have a positive impact on EI

H4: Resilience has a positive impact on EI

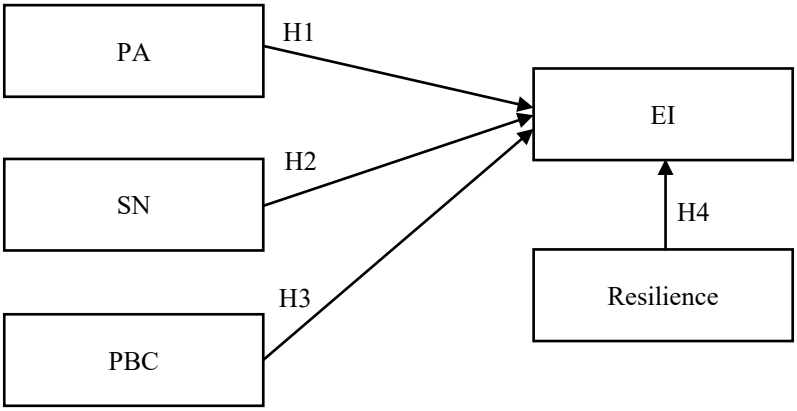


Figure 1: Proposed Study Model

To ensure clarity regarding the operationalization of the study variables, table 1 presents a summary of how each construct was measured, including the source of the scale, number of items used and items description.

Table 1: Measurement of Study Constructs and Items

Construct	Item Code	Item Description
Personal Attitudes (PA)	PA1	Being an entrepreneur implies more advantages than disadvantages
	PA2	A career as an entrepreneur is attractive for me
	PA3	If I had the opportunity and resources, I would like to start a firm
	PA4	Being an entrepreneur would give me great satisfaction
	PA5	Among various options, I would rather be an entrepreneur
Subjective Norms (SN)	SN1	My closest family members would approve of my decision to start a business
	SN2	My friends see entrepreneurship as a good career choice
	SN3	Important people in my life think I should pursue entrepreneurship
Perceived Behavioral Control (PBC)	PBC1	I am confident I can develop a successful business
	PBC2	Starting a firm would be easy for me
	PBC3	I know the necessary steps to start a business
	PBC4	I can control the creation process of a new business
	PBC5	If I tried to start a firm, I would have a high probability of success
	PBC6	I have the skills and abilities to be an entrepreneur
Entrepreneurial Intention (EI)	EI1	I am determined to create a firm in the future
	EI2	My professional goal is to become an entrepreneur
	EI3	I will make every effort to start and run my own firm
	EI4	I am ready to do anything to be an entrepreneur
	EI5	I am seriously thinking of starting a business
	EI6	I have the firm intention to start a business someday

Construct	Item Code	Item Description
Resilience (R)	R1	I tend to bounce back quickly after hard times
	R2	I have a hard time making it through stressful events
	R3	It does not take me long to recover from a stressful event
	R4	I usually come through difficult times with little trouble
	R5	I can deal with whatever comes my way
	R6	I believe I can achieve my goals, even if there are obstacles
	R7	I can stay calm in difficult situations
	R8	I believe I can handle unexpected problems
	R9	I think I am strong when facing challenges
	R10	I am able to adapt when things do not go according to plan

4. Methodology

This study followed a quantitative methodological approach with a descriptive and exploratory scope, which aimed to examine the relationships between resilience and the cognitive determinants of EI among higher education students. Data were collected through an online questionnaire administered to all undergraduate students enrolled in the Entrepreneurship course unit at the Polytechnic Institute of Setúbal (IPS), during the 2024/2025 academic year. Therefore, the sampling was non-probabilistic and intentional, based on the accessibility and relevance of the target group.

The collected responses were processed using IBM SPSS Statistics. Descriptive statistics were employed to characterize the sample. In addition, inferential statistical analyses, including factor analysis and linear regression were conducted to test the theoretical model and evaluate the proposed research hypotheses.

4.1 Instrument Design

Data was collected through a structured questionnaire composed of three main sections. The first section gathered demographic information, including age, gender, degree program, work experience, and prior self-employment experience.

The second section assessed EI using the Entrepreneurial Intention Questionnaire (EIQ) developed by Liñán and Chen (2009). The EIQ includes 20 items measuring four key dimensions: PA, SN, PBC, and EI. Items were answered on a seven-point Likert scale from 1 (Totally Disagree) to 7 (Totally Agree). The EIQ has been widely validated in cross-cultural entrepreneurship studies (e.g., Barba-Sánchez et al., 2022; Elnadi & Gheti, 2021).

The third section measured resilience using the 10 item Resilience Scale developed by Campbell-Sills and Stein (2007), a validated short form of the original scale by Connor and Davidson (2003). Respondents rated each item on a seven-point Likert scale ranging from 1 (Totally Disagree) to 7 (Totally Agree). This scale has been widely used in recent studies on psychological and entrepreneurial traits (e.g., Lozano-Díaz, 2020).

Both the EIQ by Liñán and Chen (2009) and the 10-item Resilience Scale by Campbell-Sills and Stein (2007) were selected due to their widespread use and robust psychometric validation across diverse contexts. Despite their original publication dates, these instruments remain current in the academic literature and have been employed in several recent empirical studies involving student populations (e.g., Barba-Sánchez et al., 2022; Cachón et al., 2020; Lozano-Díaz, 2020; Sampene et al., 2023). Their continued use facilitates cross-study comparability and ensures a theoretically sound measurement of the constructs under investigation.

4.2 Sample

The empirical analysis was based on a sample of 128 undergraduate students from the College of Business Administration (ESCE) at IPS. All participants were enrolled in the Entrepreneurship course unit during the 2024/2025 academic year, across four degree programs: Distribution and Logistics Management (36.7%), Marketing (25.0%), Information Systems Management (24.2%), and Human Resource Management (14.1%) (Table 3).

Table 2: Demographic Results of the Sample

Degree Program	Total number of students enrolled	Number of valid responses	Response rate (%)
Distribution and Logistics Management	72	47	65.3
Human Resource Management	28	18	64.3
Information Systems Management	71	31	43.7
Marketing	57	32	56.1

Of the total respondents, 70 (54.7%) were female and 58 (45.3%) were male. In terms of age, the majority were between 20 and 22 years old (65.6%), followed by those aged 23 to 25 (22.7%).

Regarding professional background, 51.6% of students reported having previous work experience, while 48.4% had none. Additionally, 21.9% of the participants had self-employment experience.

Table 3: Demographic Results of the Sample

Demographic Characteristics	Variable	Frequency	Percentage
Gender	Female	70	54.7
	Male	58	45.3
Age	20 to 22 years	84	65.6
	23 to 25 years	29	22.7
	26 to 28 years	4	3.1
	≥ 29 years	11	8.6
Course	Distribution and Logistics Management	47	36.7
	Human Resource Management	18	14.1
	Information Systems Management	31	24.2
	Marketing	32	25
Work experience	Yes	66	51.6
	No	62	48.4
Self-employment experience	Yes	28	21.9
	No	100	78.1

5. Results

To begin the analysis, a factor analysis was conducted to reduce the dimensionality of the variables derived from the Theory of Planned Behavior (TPB) - namely, PA, SN, and PBC – as well as the additional constructs of EI and Resilience. Cronbach's alpha was employed to assess reliability, resulting in values ranging from 0.792 to 0.968 (Table 4). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy yielded a value of 0.889, while Bartlett's test of sphericity was statistically significant ($p < 0.000$), confirming the appropriateness of applying factor analysis. The extraction method used was Principal Component Analysis with Varimax rotation. These results confirm that the constructs under study are adequately represented and statistically supported.

As presented in table 4, item PA1 did not load strongly onto the PA factor, item EI1 showed a similarly weak loading on the EI factor, and items R3 and R4 demonstrated low loadings on the Resilience factor. Consequently, these items were excluded from subsequent analyses in order to enhance the reliability and validity of the constructs. To evaluate discriminant validity, the correlation values between the different construct groups were examined. The results confirmed that each item correlated more strongly with its respective construct than with others, supporting the adequacy of the factor structure and the distinctiveness of the constructs.

Table 4: Rotated Components Matrix

Factor	Loadings	Cronbach's Alpha	Variance Explained
PA1	-	0.915	4.0%
PA2	0.810		
PA3	0.703		
PA4	0.700		
PA5	0.747		
SN1	0.805	0.792	6.2%
SN2	0.880		
SN3	0.744		
PBC1	0.706	0.895	8.5%
PBC2	0.760		
PBC3	0.841		
PBC4	0.748		
PBC5	0.757		
PBC6	0.720		
EI1	-	0.968	43.8%
EI2	0.807		
EI3	0.709		
EI4	0.846		
EI5	0.823		
EI6	0.859		
R1	0.843	0.926	13.5%
R2	0.792		
R3	-		
R4	-		
R5	0.818		
R6	0.788		
R7	0.853		
R8	0.759		
R9	0.678		
R10	0.715		

Extraction method: Principal components analysis; Varimax rotation method with Kaiser standardization

Subsequently, to test Hypothesis H1, H2 and H3 of the study, a linear regression analysis was conducted using PA, SN, and PBC as independent variables, and EI as the dependent variable. The model explained a substantial proportion of the variance in EI, with an R-squared value of 0.621, indicating a strong predictive relationship.

In addition, a separate linear regression was performed to assess the relationship between Resilience (independent variable) and EI (dependent variable) (Hypothesis H4), in order to explore its individual contribution. This model yielded an R-squared value of 0.365, suggesting that resilience also plays a meaningful, although more moderate, role in predicting EI.

The results of both regression models are illustrated in Figure 2.

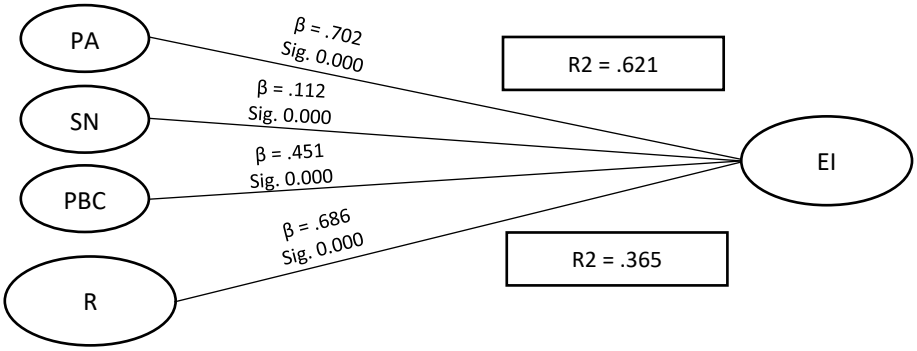


Figure 2: Linear Regression of Study Model

Note: PA = Personal Attitudes; SN = Subjective Norms; PBC = Perceived Behavioral Control; R = Resilience; EI = Entrepreneurial Intention

The results obtained from the linear regression analysis provide empirical support for Hypotheses H1, H2 and H3, indicating that PA, SN, and PBC all exert a positive influence on students' EI. Nevertheless, while SN contribute positively, their explanatory power is considerably weaker compared to the other constructs examined. These findings are consistent with previous research (e.g., Kolvereid 1996a; Kolvereid, 1996b).

In addition, Hypothesis H4 - which posits that Resilience positively influences EI - was also supported by the regression analysis, although the effect size was more modest.

6. Conclusions

6.1 Discussion

This study set out to explore the role of resilience and TPB components (PA, SN and PBC) in shaping EI among undergraduate business students. The empirical findings confirm that PA and PBC are strong predictors of EI, while SN, though statistically significant, had a weaker influence – consistent with prior research suggesting that personal and efficacy-related factors often outweigh social influences in entrepreneurial decision-making.

Moreover, resilience demonstrated a moderate and positive association with EI, confirming its relevance as a psychological resource that supports the formation of EI.

These findings reinforce the relevance of combining cognitive-motivational models with psychological attributes to obtain a more holistic understanding of EI.

6.2 Theoretical Contributions

This study contributes to literature in two key ways:

1. Extension of the TPB model: By integrating resilience into a TPB-based model, this research proposes a more psychologically enriched framework for explaining EI, aligning with recent calls for broader conceptualizations that include emotional and adaptive traits.
2. Empirical validation: The study validates the TPB constructs and resilience scale in a Portuguese higher education context, confirming their structural consistency and relevance for entrepreneurship research among students.

6.3 Implications for Entrepreneurship Education

The findings have several implications for entrepreneurship education in HEIs:

- Beyond knowledge and skills: While traditional entrepreneurship curricula focus on knowledge transfer and skill development, the results suggest the value of also fostering psychological resilience among students.
- Developing adaptive mindsets: Introducing reflective practices, experiential learning, and failure-tolerant environments may strengthen students' ability to cope with uncertainty – a critical asset in entrepreneurial contexts.

- Supporting EI formation: By recognizing resilience as a complementary factor to attitudes, norms, and control beliefs, educators can adopt a more integrative approach to developing entrepreneurial potential.

6.4 Final Conclusions

In sum, this study confirms the theoretical validity of the TPB in explaining EI among business students and introduces resilience as an additional factor that enhances our understanding of entrepreneurial motivation.

By addressing both cognitive and psychological dimensions, the research provides a more comprehensive model of how students form EI and offers insights that can inform the design of more effective entrepreneurship education programs.

6.5 Limitations and Future Research

The main limitation of this research is the non-representativeness of the sample, as it was restricted to students from a single HEI and limited to business-related degree programs. As such, generalizations to the broader student population should be made with caution. For future research, it is recommended to expand the sample to include students from multiple institutions and diverse academic fields, in order to enhance external validity.

Ethics Declaration

This research did not require formal ethical clearance as it did not involve any vulnerable populations or sensitive topics. All participants provided informed consent prior to their participation in the study.

AI Declaration

No generative artificial intelligence (AI) was used in the writing or editing of this work.

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From Idea to Business Plans: Designing a Seminar for Teaching Digital Health Entrepreneurship

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Abstract: Technology entrepreneurship, together with its subfields such as digital health entrepreneurship, is gaining increasing attention, with digital transformation playing a pivotal role in shaping its landscape. This transformation has the potential to revolutionize various industries. However, technology entrepreneurship, in particular, demands a unique set of entrepreneurial competencies. To address this, we designed a seminar focused on the healthcare sector, enabling graduate students to explore the field of digital health entrepreneurship. The seminar guides students through the process of developing a Software as a Medical Device (SaMD) business model with a focus on the European Union (EU). This paper presents the conceptual design of the seminar and evaluates its effectiveness based on seminar results and participant feedback. In the seminar, students work in teams, assuming the role of an early-stage startup team in the digital health industry. Through a multi-stage design process, they identify healthcare needs, apply creative ideation techniques to generate business ideas, and refine them into comprehensive business models. The final stage involves pitching their business concept to potential investors. Additionally, seminar participants are introduced to EU medical device regulations and reimbursement pathways to develop viable revenue models. The seminar is structured around an action-based learning approach. Students first receive theoretical input, which they then apply practically to their case studies. Their work is presented in intermediate sessions, where they receive feedback from peers as well as supervisors. To support collaboration and interactive learning, several custom-designed canvases are integrated into digital interactive tools. Seasoned entrepreneurs hold guest talks to give a complementary perspective through their experience. Having been conducted over multiple semesters, the seminar has received positive feedback from participants. This work offers valuable insights into the key aspects of developing a seminar for the entrepreneurial journey of building a SaMD in the EU. It may serve as inspiration for other researchers and facilitators in the fields of technology entrepreneurship and broader entrepreneurship education.

Keywords: Digital health, Entrepreneurship Education, Seminar, University, Teaching, Software as a Medical Device

1. Introduction

Technology entrepreneurship is a tool that supports growth for individuals, businesses, regions, and nations (Bailetti, 2012). Bailetti (2012) defines technology entrepreneurship as: "…an investment in a project that assembles and deploys specialized individuals and heterogeneous assets that are intricately related to advances in scientific and technological knowledge for the purpose of creating and capturing value for a firm." (Bailetti, 2012, p.5). A central outcome of technology entrepreneurship is the emergence of new technology-based firms (NTBFs). These NTBFs are particularly important in tackling issues prevalent in today's world (Presse and Terzidis, 2017). They are acknowledged for their strong potential to drive growth and make a substantial impact on the broader economy (Ferguson and Olofsson, 2004). NTBFs play a key role in spreading technological innovations and driving industrial development (Arantes et al, 2019). In healthcare, technology entrepreneurship can be described as the process of creating, initiating, and growing ventures that design new technologies, products, and services aimed at delivering value to patients and various stakeholders such as medical staff, healthcare institutions, and insurers (Kulkov et al, 2023). With healthcare systems worldwide facing challenges such as rising costs (Wulfovich, 2020) and a lack of qualified healthcare staff, in recent years, digital health technologies have provided the potential to tackle them. Nowadays, digital health solutions can provide treatment support for diseases, they can help track fitness, make diagnoses, and support the prevention of diseases. Digital health can be seen as an umbrella term (WHO, 2019). It encompasses concepts such as mobile health and telemedicine (WHO, 2019).

However, despite its potential, entrepreneurs in the digital health sector are confronted with several challenges, especially if they develop Software as a Medical Device (SaMD). These include strict regulatory requirements, complex stakeholder landscapes, and difficulties in securing funding to cover pre-market expenses. In addition, aspiring founders should have unique knowledge and entrepreneurial competencies to successfully establish a startup. University-based educational programs can equip prospective entrepreneurs with the knowledge and competencies needed to address these challenges. They can guide entrepreneurs in the development of a sustainable business model, which is crucial for success. In complex industries where many startups are not able to bring their solutions into the market successfully, a university seminar can provide essential preparation for

navigating early-stage challenges. To our knowledge, there is no existing literature that explores how seminars can be designed for highly-regulated, multi-stakeholder environments, and less specifically for the SaMD domain. Therefore, we formulate the following research question (RQ):

- RQ: How can we design a university seminar on digital health entrepreneurship that enables participants to develop a business model for a SaMD in the European Union?

The seminar focuses on the SaMD industry of the European Union (EU) as a subfield of the digital health sector. The focus was chosen for several reasons. First, the growing SaMD sector offers opportunities to tackle pressing healthcare issues, including the lack of quality care and the shortage of skilled medical personnel. Second, the SaMD industry is perceived as particularly complex, especially due to strict regulations and multiple stakeholders. This is exactly where a seminar can provide the most valuable support. Lastly, a specialization allows for in-depth coverage of the topic and the delivery of detailed information.

Our work provides valuable insights into structuring a digital health entrepreneurship seminar focusing on the EU SaMD industry. Researchers and facilitators in the fields of digital health entrepreneurship and, in a broader sense, entrepreneurship education can benefit from the seminar design approach and apply it in similar industries. Additionally, our work is of value to the literature on entrepreneurship education. By focusing on the development of a SaMD business model in the EU, our seminar fills a crucial gap and stands out as a unique contribution.

The following work is structured as follows: In the subsequent subsection, we will provide an overview of related work. Thereafter, we will focus on the methodological approach followed in this work. The third section gives an overview of the results. In the fourth section, we discuss the results before we conclude the work.

1.1 Fundamentals and Related Work

SaMD is software intended to be used for at least one medical purpose that is performed without being part of a hardware medical device (IMDRF, 2014). In the EU, SaMD is regulated under European Union medical device regulations. SaMD includes a wide range of software, from apps used by private individuals to manage conditions like migraines to clinical tools used by physicians for disease diagnosis.

Several papers focus on the design of entrepreneurship seminars, with some of them focusing on entrepreneurship in the medical device industry. For example, Suryavanshi et al (2004) describe a course designed to promote entrepreneurship among students interested in medical informatics. Yock, Brinton, and Zenios (2011) focus on teaching biomedical technology innovation. Greven et al (2020) developed a course designed for studies that focuses on teaching entrepreneurial fundamentals in combination with the challenges of home healthcare for older adults, enabling students to develop practical solutions. One of the most well-known processes of innovating medical technologies is the Biodesign Program at Stanford (Yock et al, 2015). Stanford Biodesign's goal is to educate future pioneers in health tech innovation (Fuerch, Wang and Wert, 2021). The process consists of three phases: identify, invent, and implement (Yock et al, 2015). The *Identify* phase involves finding and screening needs. Based on the selected needs, concepts are generated in the *Invent* phase. The generated concepts undergo a screening process, after which the optimal solution is chosen. In the final phase, the *Implement* phase, a strategy for the selected concept is developed as well as a business plan. The process is iterative, allowing for adaptations along the way (Yock et al, 2015). Despite these works, to our knowledge, there is no seminar explored in the literature that specifically focuses on teaching the development of a SaMD business model in the context of digital health entrepreneurship.

2. Method

This paper adopts the case study methodology by Yin (2009). We build upon a single holistic case study design to report on the design of a university seminar focused on digital health entrepreneurship. In the following, we provide the five key components of a case study design according to Yin (2009), including the study's question, proposition, unit of analysis, the logic for linking data to the proposition, and criteria for interpreting the findings.

Based on the previously introduced research question, the **proposition** of this case study is that a seminar on digital health entrepreneurship can be designed to enable students to develop a business model for a SaMD in the EU. The **unit of analysis** is a seminar conducted at Karlsruhe Institute of Technology (KIT), a technical university located in the south of Germany. In three seminar runs, a total of 58 graduate students from disciplines such as industrial engineering and computer science participated. To **link data to the proposition**, we

collected two types of data during the seminar. Primary, session artifacts such as student pitch decks and business plans were analysed. These data were subsequently triangulated with the results from the standardized KIT seminar evaluation questionnaire collected for all three seminar sessions. The evaluation focused on dimensions such as perceived learning outcomes, relevance of seminar content, and overall satisfaction. This triangulation enables the establishment of patterns consistent with or diverging from the initial proposition. **Criteria for interpreting the findings** included the quality and completeness of the pitch decks and the business plans. Additionally, criteria include frequency and consistency of positive student evaluations and alignment between the intended learning outcomes and student-reported gains. Patterns of improvement or consistent challenges across both seminar runs were also used as indicators of effectiveness and reproducibility.

3. Results

3.1 Seminar Design

The overarching goal of the seminar was to teach graduate students from various disciplines on the topic of digital health entrepreneurship, thereby enabling them to develop entrepreneurial competencies to found a startup in digital healthcare. The following learning objectives should be achieved through the seminar. First, students should be encouraged to take on the role of entrepreneurs to develop relevant competencies and entrepreneurial thinking. According to Stagars (2014), entrepreneurship is rather a mindset than a job. Students should be taught and experience the required mindset in a simulated environment. Therefore, they identify unmet needs and use ideation methods to find solutions. Second, students should be taught the basics of the digital health industry, in particular the SaMD industry. The SaMD sector is highly complex. Therefore, topics include the EU medical device regulations, reimbursement strategies, besides classical entrepreneurship topics such as business models and pitching. Lastly, the students learn soft skills that are important for founders. By working in teams and regularly pitching their ideas and current status to all seminar participants, the students improve their presentation and communication skills as well as teamwork capabilities.

3.1.1 Pedagogical Framework

The seminar builds on an action-based learning approach, which is grounded in the work of Revans (1957). One aspect of this approach is that students work in teams throughout the seminar. The seminar, therefore, functions as a simulator for developing a potential SaMD business model. It consists of short theoretical input sessions from the facilitators, followed by time-boxed group work and intermediate presentations of the results, during which facilitators and other team members can provide feedback. Warm-up elements are integrated within the seminar so that students get comfortable with the setting and to encourage participation. Outside the seminar, students were expected to complete assignments that were started in the seminar. Digital collaboration tools are used to document the work within and outside the seminar and enable remote teamwork. These digital collaboration tools were set up with a mixture of custom and established canvas-like tools to support the work. Custom tools focused especially on SaMD-specific elements, such as medical device regulations and essential business model elements. Additionally, the seminar is supplemented by input talks from seasoned entrepreneurs.

3.1.2 Seminar Structure

The seminar consists of six full days, held every one to two weeks. It begins with an introduction to digital health entrepreneurship, followed by a team-building activity designed to foster collaboration among participants. Research shows that larger, more personality-diverse startup teams show an increased likelihood of success (McCarthy et al, 2023). Therefore, diverse teams are formed based on individual personality traits.

After this initial session, the seminar proceeds through a structured five-phase approach, which includes the phases: Identify, Invent, Decide, Define, and Sharpen. These phases are inspired by the Biodesign process (Yock et al, 2015), a methodology traditionally used for commercializing medical technologies. Much like the principles of design thinking, this approach encourages an iterative process, allowing participants to revisit and refine previous phases as needed. This flexibility supports deeper insight and more effective problem-solving, as illustrated in Figure 1.

Towards the conclusion of the seminar, each team presents their project pitch in front of a jury, showcasing the results of their work. Additionally, a comprehensive written business plan must be submitted.

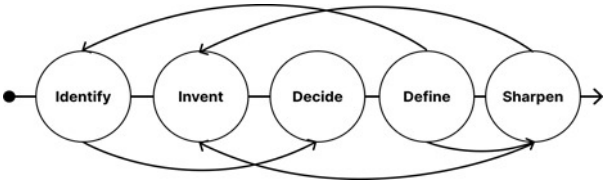


Figure 1: Overview of the five-phase approach applied in the seminar

In the first phase, *Identify*, the topic of digital health is introduced by stating its origin and showing a selected number of successful digital health startups. Thereby, it is already shown which startup develops a SaMD to foster initial understanding of the concept. Subsequently, the goal of the seminar is introduced, which is to develop a business model for a SaMD. Next, the concept of need statements was presented, which is inspired by Biodesign (Yock et al, 2015). Therefore, healthcare problems are identified by students, which can be summarized in a specific need that can potentially be addressed by a digital solution.

In the *Invent* phase, which is the second phase, the focus lies on ideation. Here, students are required to use creative techniques such as brainstorming to develop first draft solutions for each of their problem statements. This ideation process is time-boxed and supported through ideation anchors, which are used to take a certain perspective on the solution space. Therefore, different ideation anchors are introduced, such as different digital technologies, the healthcare cycle of care, and the specific medical speciality levels, which can serve as a focused perspective to generate ideas. Participants cluster their ideas thematically after the ideation.

In the third phase, *Decide*, goodness criteria are used to create a ranking of the best to worst idea. Ideas should be precise enough so that they can be rated. Rating is conducted within the startup team and with experts from the domains of business, medicine, regulatory, and engineering. Finally, the top three ideas are selected, and the best idea is followed for the consecutive steps. Still, at a later stage, the startup team can make the decision to return and continue the process with another idea, if deemed necessary.

In the subsequent phase, *Define*, potential customers are identified through the persona concept. Additionally, frameworks like the jobs-to-be done framework (Ulwick, 2016) are utilized to empathize with potential customers and ultimately develop a value proposition through the Value Proposition Canvas (Osterwalder et al, 2014). Additionally, the understanding of medical devices and the regulatory requirements of EU medical device regulations are discussed and identified by the students for their selected ideas.

In the final phase, *Sharpen*, a key consideration is potential revenue models, including self-payer options, business-to-business models, and reimbursement pathways. Students are introduced to various reimbursement pathways through which revenue can be generated from payers such as health insurers. This is a crucial element of the entire process. Additionally, other essential elements in this phase include competitors, market potential, relevant stakeholders, and core activities within the scope of the idea.

Finally, after going through these phases, the students put their learning together into a business model. Once the business model is set, a pitch preparation session helps the students to understand relevant aspects of an investor pitch. The final pitch takes place in a more official setting in front of a jury of experts. Within this seminar element, students pitch their idea and then have to answer the jury's questions before the seminar concludes.

3.2 Evaluation

To evaluate the seminar's outcomes, two researchers reviewed the pitch decks and business plans. For the evaluation, the researchers followed the structure and key section points outlined in the EXIST Business Start-up Grant template (EXIST, 2025). Furthermore, specific elements relevant to digital healthcare were considered, including revenue models such as reimbursement and the medical device strategy. In addition to content, the presentation itself was assessed: the pitch needed to follow a coherent narrative and be delivered in a persuasive and engaging manner. The visual design of the pitch deck was also considered as part of the overall evaluation.

The analysis of the pitch decks showed that the teams were able to generate viable business models, containing the typical elements of pitch decks just mentioned.

The seminar itself was evaluated through the standard seminar evaluation questionnaire of the KIT. Within this questionnaire, Likert-scaled questions are used to assess the seminar. The results from the three evaluation rounds are described below. The questions most relevant for this work from the KIT evaluation questionnaire

are shown below in Figure 2 for a sample of 58 participants. Some participants omitted responding to all questions. Participants provided feedback on aspects such as learning outcomes, course structure, clarity of objectives, presentation feedback, instructional support, and discussion opportunities. The mean ratings ranged from 1.98 to 2.44, indicating consistently positive responses across items, especially for the overall course rating. Standard deviations ranged from 0.71 to 1.04, reflecting moderate dispersion in participant responses. The results are visualized using horizontal reference lines and error bars to represent mean scores and standard deviations.

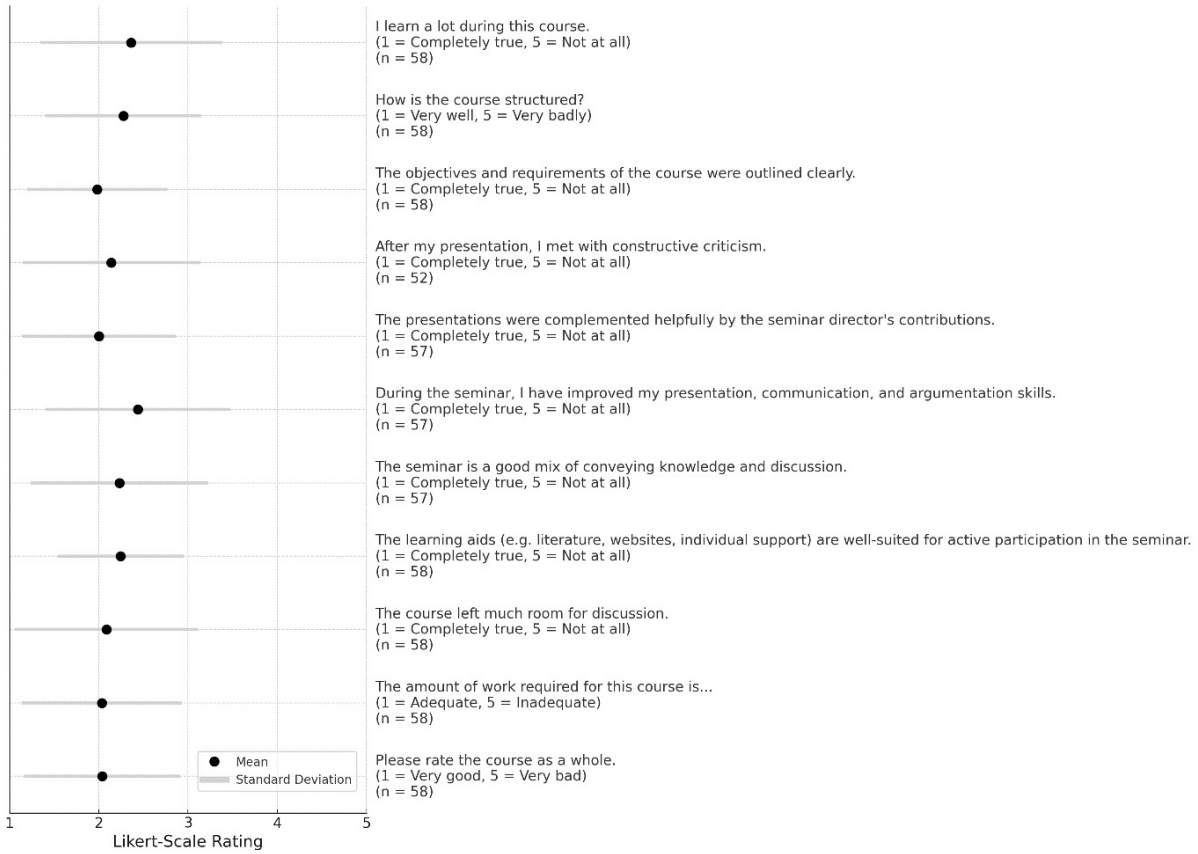


Figure 2: Results from the Karlsruhe Institute of Technology seminar evaluation questionnaire

4. Discussion

4.1 Key Findings

Based on the data collected, a key finding was that both the pitch decks and the business plans were of high quality. Several factors may explain this outcome. First, the seminar provided students with a strong foundation for developing their business models. Second, the students participated in a dedicated pitch training session before the final presentations. In this session, they practiced their pitches in front of the facilitators and received targeted feedback.

To continue, the evaluation of the seminar showed that its design is effective in preparing students to potentially become SaMD founders. Students reported that they acquired substantial knowledge and particularly appreciated the constructive feedback provided by the facilitators. Accordingly, the seminar design offers a transferable model for facilitators in this field, supported by its proven success in multiple prior implementations.

The action-based learning approach proved to be effective and was highly appreciated by the students. Applying newly acquired theoretical knowledge immediately in team settings was perceived as both efficient and engaging. To support this, theoretical inputs were deliberately kept short to maintain students' attention, allowing more time for group work, discussions, and questions. In the subsequent student presentations, the content was directly linked to their practical work, making the discussed topics more tangible and easier to understand.

For the last two seminar rounds, the final pitch took place at the facilities of a health insurer, which also had a representative on the jury. In addition to the students and the jury, the event was open to external guests, creating a broader and more diverse audience. This setting gave the final pitch the character of a professional event, with refreshments and a realistic presentation environment. The format has proven effective, as students tend to take the situation more seriously, and the involvement of a health insurer in the jury adds a layer of authenticity through relevant and practical questions.

4.2 Theoretical and Practical Contributions

From a theoretical perspective, this work contributes to the field of entrepreneurship education within the context of technology entrepreneurship. We demonstrate that it is feasible to design a university seminar on a complex topic, which is the development of business models for SaMD in the EU context. In doing so, we expand existing knowledge by identifying key elements that such a seminar should include. These include effectively integrating often underestimated but highly relevant aspects of entrepreneurship, such as regulatory requirements and diverse revenue models. Practically, the seminar could serve as a blueprint for other seminars in the domain of digital health entrepreneurship, as well as other technology entrepreneurship seminars that are highly regulated and have multiple stakeholders.

4.3 Limitations

This work is not without limitations. One limitation is that we report on a case study in which we are facilitators. This can induce potential bias. We tried to reduce this bias by collecting sufficient data regarding the pitch decks and from students themselves. Furthermore, we discussed potential biases within the team and followed the case study methodology of Yin (2009) to reduce biases further. Additionally, the data reported within this study do not enable the study of group differences between the three seminars.

4.4 Next Steps

Next steps for this work could be to run an additional round of this seminar to gather additional data, or to even let external experts rate the pitch decks to gather more objective data. Lastly, the transition from problem description to ideation was sometimes perceived as too abrupt by seminar participants. In future iterations, dedicating more time to preselecting and refining need statements could help, although this remains challenging given the seminar's six-session format.

5. Conclusion

This study demonstrates that a university seminar can be effectively designed to foster understanding of the key aspects relevant for developing a business model for a SaMD. By combining action-based learning, interdisciplinary teamwork, and structured content grounded in the Biodesign process, students were able to gain entrepreneurial competencies, digital health knowledge, and essential soft skills. The seminar outcomes, including high-quality pitch decks and positive student evaluations, support the proposition that such a course structure is both effective and reproducible. The findings contribute to both theory and practice by offering a blueprint for entrepreneurship education in regulated and complex fields such as SaMD and digital health.

Ethics Declaration

The research was conducted in accordance with relevant ethics guidelines of the Karlsruhe Institute of Technology, and it was exempt from human participant ethics review.

AI Declaration

The authors used the generative artificial intelligence tool ChatGPT with GPT-4 for spelling, grammar, and style improvements.

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Innovation Management in Small and Large Companies: Comparative Insights From Switzerland

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Abstract: Innovation is a key driver of growth, competitiveness, and technological progress at both micro and macro levels. Despite Switzerland's position as the world's most innovative country, there is limited research on how innovation is managed within its businesses. This study addresses this gap and explores how small and large Swiss companies establish innovation strategies, processes, and structures to achieve organisational goals. This comparative study examines innovation management in small (10–49 employees) and large (250+ employees) Swiss companies across various industries, using qualitative semi-structured interviews with innovation leaders. Findings show that while both groups prioritize innovation, their approaches differ. Large companies rely on structured processes but often face bureaucratic barriers to radical innovation. In contrast, small firms benefit from agility and intuitive practices but may lack efficiency due to informal processes and limited evaluation. Innovation culture is easier to shape in small firms through direct leadership, whereas large firms struggle to encourage risk-taking. The study suggests that large firms can enhance innovation by adopting more agile methods, while small firms could benefit from more structured planning and evaluation. This paper enriches academic understanding of innovation management by providing a qualitative comparison of small and large Swiss businesses and offers practical insights for companies and policymakers aiming to strengthen innovation capabilities.

Keywords: Innovation Management, Innovation Practices, Small and Large Companies, Switzerland

1. Introduction

Innovation is a key driver of competitiveness at both the company and national level creating a reinforcing cycle to foster business growth and economic development (Dobrinsky, 2008). For 14 consecutive years, the Global Innovation Index published by the World Intellectual Property Organization (2024) has been ranking Switzerland as the leading country in innovation. According to the Swiss Federal Statistical Office (n.d) in 2022 over 99% of all companies in Switzerland were SMEs with fewer than 250 employees, employing over 66% of Switzerland's working population. SMEs are the backbone of the Swiss economy and key to innovation. However, despite Switzerland's leadership, technological and societal changes challenge companies of all size (Meyer et al., 2023)

The latest report on innovation and digitalisation in the Swiss private sector, indicates a 3.7 % rise of companies actively engaging in R&D. At the same time, the average share of R&D expenditure on the turnover remained constant compared to the previous period, meaning that the concentration of R&D expenditure in the economy has decreased. (SBFI, n.d.) According to the European Innovation Scoreboard 2024, Switzerland's closest competitors, the Nordic countries, are making strong advances in innovation while Switzerland achieved only modest gains. Switzerland has recently made progress in venture capital availability and SME product innovation, reversing a long decline. However, SMEs introducing business process innovation is decreasing.

Switzerland's innovation ecosystem is characterized by a strong interplay between research institutions, private sector, and government support. For example, to support SME innovation, the Swiss innovation agency Innosuisse (2025) launched a programme for companies with fewer than 500 employees. This is in line with research that suggests that Swiss companies need to review their innovation management efforts to stay competitive.

Businesses need to increase the effectiveness and efficiency of internal innovation activities by means of systematic innovation management comprising a set of strategic and operational tasks for planning, organising and controlling innovation processes (Gaubinger et al., 2015). In other words, innovation management is critical for business to remain competitive. Amid declining R&D spending in Switzerland, we conduct this study to explore key elements of innovation management, including innovation strategy, process, structure, culture, and innovation tools, from the perspective of large and small companies in Switzerland. It identifies internal enablers, differences, challenges, and opportunities, based on an empirical study addressing the following research questions:

1. How do small and large companies in Switzerland develop their innovation strategies, processes, and structures to achieve organisational goals?
2. What are the key factors influencing innovation culture, including leadership and employee engagement?
3. How do small and large companies manage resources, measure outcomes, and leverage tools to foster innovation?

This study will inform the discussion on innovation management in Swiss small and large businesses and its role in securing Switzerland's future as an innovation leader, while also providing input on potential support programmes

2. Theoretical Background

The ability to innovate products, services, processes and business models is essential for success in the market and boosting growth (Carrillo et al., 2015). The critical importance of innovation has led to extensive debate and development around its definition.

The meaning of innovation has evolved through economic, industrial, and technology development, increased role of customer satisfaction and its role as a management process (Trott, 2008). According to Trott (2008), innovation is the management of all activities involved in the process of idea generation, technology development, manufacturing, and marketing of a product or manufacturing process or equipment. Building on this, innovation can be further understood through four distinct lenses, categorising the type of change involved (Bessant & Tidd, 2024). These include alterations to the product itself (what is offered), the process by which it's created and delivered, the position or context in which it's introduced, and the fundamental paradigm or underlying mental models guiding the organisation's actions. Over time, innovation went from being an internal process to a collaborative approach called open innovation, defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation" (Chesbrough, 2006), a future that will be more extensive, engaging, and involve a wider variety of participants.

To handle these increasingly complex and evolving innovation processes effectively, a structured approach is needed, which is where innovation management comes in. Literature presents us with a wide range of definitions of innovation management. According to Havlíček et al. (2013) it refers to the structured process of generating, validating, and implementing new ideas within an organisation. Gaubinger et al. (2015) state that goal-oriented steering and shaping of innovation activities within a company require structured and coordinated activities aimed at an innovation's successful introduction. These definitions show that effective innovation doesn't happen in a vacuum. Achieving successful innovation outcomes relies on carefully managing and integrating diverse elements. For this paper we focus on the five elements according to Birkenmeier & Brodbeck (2020), which are innovation strategy, processes, organisational culture, and structure as well as innovation tools. While broader aspects like external collaborations, digital transformation, and strategic R&D investment are increasingly important in today's innovation landscape, this paper primarily focuses on the internal dimensions of innovation management within organisations. The subsequent sections will analyse these key elements of innovation management.

2.1 Innovation Strategy

Managing the innovation strategy requires understanding the what, why, and when of innovation activity. This means developing, reviewing, and updating an innovation policy and strategy consistent with the organisation's mission and setting goals for innovation (Igartua et al., 2010). The innovation strategy must be derived from the corporate strategy. The innovation strategy must reflect the objectives, priorities and framework conditions of the corporate strategy and refine or concretize them (Schori & Roch, 2012).

An innovation strategy explicitly defines key aspects such as the required level of innovativeness (e.g., the percentage of future revenue to be generated through innovations), the strategic focus areas for innovation (e.g., CO2 reduction initiatives), and the permitted or desired types of innovation (e.g., product, process, or business model innovations) (Augsten et all., 2017). Crucially, the innovation strategy also dictates the allocation of resources, including the strategic investment in research and development (R&D), to achieve defined innovation goals (Birkenmeier & Brodbeck, 2020).

In principle, the development of an innovation strategy is very company specific. It is therefore not possible to make a general distinction between companies. Due to their size and the corresponding resources available,

large companies can usually invest more resources in the structured development of the innovation strategy, in-depth analyses, and market research. In contrast, communication and implementation are significantly easier for small companies. (Hugentobler et al., 2020)

2.2 Innovation Process

Innovation process are the general business processes and practices that enable teams to operate effectively and collaborate toward a common goal (Dougherty, 1999). Understanding and defining a clear innovation process helps organisations create a common framework for discussion, establish metrics, and set goals for each stage. Desouza et al. (2009) identified five key stages: idea generation and mobilization, screening and advocacy, experimentation, commercialization, and diffusion and implementation.

Traditionally, large manufacturing organisations used stage-gate systems for innovation project approval, development, and costing. However, these proved too linear and rigid for changing markets. The Agile development process, originating from the software industry, offers a more adaptive, collaborative, and change-thriving approach. A hybrid Agile–Stage-Gate model integrates the best of both. (Cooper & Sommer, 2018)

Literature suggest that small companies face several challenges regarding their innovation processes, mainly due to their limited resources. This can be partially solved by utilising the ecosystem of partners, suppliers and customers. Through close cooperation, companies can take up ideas from external partners and develop them into innovations. (Schori & Roch, 2012) Large companies have substantial resources but must allocate them carefully to avoid limiting their impact.

2.3 Innovation Structure

For innovation to flourish, suitable organisational structures, that enable collaboration across functional lines are essential (Dougherty, 1999). Organisational innovation structure can foster cooperation and reduce uncertainty, enhancing ways to deal with the challenges and change (Ferraro & Iovanella, 2016). This includes establishing structures that facilitate engagement with external networks, partnerships, and open innovation initiatives. Above all, the structure must support the innovation strategy and steer innovation efforts in the direction of the goals set by the strategy. Additional structures should be kept to a minimum and anchored on a broad basis so that everyone is involved in innovation. (Birkenmeier & Brodbeck, 2010)

Large companies often struggle with rigid processes and separate disciplines, making radical innovation difficult. While they excel at incremental improvements, they face challenges when competing with agile startups that quickly adapt to customer needs and implement bold ideas. To overcome this, large firms create dedicated structures like innovation hubs, incubators or others to foster innovation. (Sauberschwarz & Weiß, 2018) In small companies, forming interdisciplinary innovation teams is challenging, so external participants like customers, suppliers, or consultants are often included. The successful formation and operation of these teams also depend on the availability of diverse skills and human resources. An innovation manager is essential to maintain clear responsibility. This role can be filled by the CEO, a board member, or an external consultant — each bringing different strengths. (Schori & Roch, 2012)

2.4 Innovation Culture

Corporate culture plays a crucial role in creating space for innovation. It includes the mindset and norms that allow individuals and teams to think imaginatively, to take prudent risks, and to seek out, create and introduce innovative solutions. (Dougherty, 1999) A strong innovation culture also fosters the development of critical skills and the effective utilisation of human resources necessary for driving innovation. Traditional hierarchical corporate structures places too much focus on process optimisation hindering culture that fosters innovation, which requires prioritising values, attitudes, and creativity. Furthermore, "empowerment" is key: leaders must actively support innovation and create conditions that enable innovation to thrive. (Augsten et al., 2017) The central question remains how leaders can effectively shape a culture that promotes innovation? Augsten et al. (2017) identify eight elements that contribute to a strong innovation culture: openness, freedom to dream, personal growth, diversity, collaboration, patience, embrace failure and space for innovation.

Innovation culture is easier to shape in a small company, as management is closer to employees. Leading by example, promoting desired values, and maintaining open, two-way communication are crucial. Employees should be encouraged to propose and pursue new ideas, with active appreciation for their contributions. (Schori & Roch, 2012)

2.5 Innovation Management Tools (IMTs)

Innovation management tools are a way of thinking and finding creative solutions within the company to achieve the strategic objectives. In this context, IMTs can be seen as a range of techniques that help companies to enhance creative efforts in developing new ideas. There is no set of developed and proven IMTs for solving specific challenges the business faces. (Hidalgo & Albors, 2008) IMTs support the entire internal innovation process, encompassing methods for identifying innovation potential, assessing customer needs, evaluating ideas, monitoring technological and competitive developments, and managing projects (Birkenmeier & Brodbeck, 2020).

When it comes to idea generation, there are two types of tools to distinguish: systematic idea generation through various creativity methods, and random idea generation. Examples of systematic idea generation include brainstorming, the 6-3-5 method, brainwriting, mind mapping, and more. In random idea generation, it is important to utilize the potential of all employees and establish an idea management system that allows the systematic collection of individual ideas. All ideas must then be systematically evaluated and further developed if potential is recognized. (Birkenmeier & Brodbeck, 2010)

Tools should be initiated by the person responsible for innovation, although small companies often lack this expertise. The management has often other priorities and tasks, so it may make sense to hire external consultants for these competencies (Schori & Roch, 2012). In large companies, it makes sense to build these competencies internally and, if necessary, develop methods tailored to the company**.**

These key elements of innovation management identified in the theoretical study form the basis for the qualitative research and the interviews with companies.

2.6 Regional Context of the Study

Although Switzerland ranks very high in global innovation, the concentration of R&D expenditure in the economy has decreased (SBFI, n.d.) This particularly applies to Swiss SMEs who face difficulties to innovate. There is limited research on innovation management across Swiss businesses. It primarily examines some, but not all, individual elements of innovation management like innovation culture (J.-U. Meyer, 2014); idea finding and project development (Luggen et al., 2005) or industry affiliation like construction (Girmscheid & Hartmann, 2001) and others. This qualitative study examines key elements of innovation management: innovation strategy and process, structure, culture and tools in large and small Swiss enterprise. It identifies differences, challenges, and opportunities across businesses of different sizes.

3. Methodology

Alongside the theoretical literature review, a qualitative study was conducted with 12 Swiss companies, 6 large and 6 small from various industries in the German-speaking region, selected for its role as the country's economic powerhouse (Federal Statistical Office, n.d.). To gather relevant input, innovation-focused companies from various industries, including startups and established businesses, were selected. In-depth interviews were conducted with employees directly involved in innovation, such as innovation managers and executives.

A structured interview approach with predefined guidelines allowed for comparative analysis. Interviews covered five key areas from the literature: innovation strategy, process, structure, culture, and tools. To ensure openness and protect sensitive information, data was anonymized during processing and analysis.

The study uses the Swiss Federal Statistical Office's company size classification.

Table 1: Swiss Federal Statistical Office's company size classification

Size category	Number of employees	
Micro company	1-9	SMEs
Small company	**10-49**	
Medium company	50-249	
Large company	**>250**	

Small and large companies were chosen for the study as they together represent 54.8% of the Swiss workforce (Bundesamt für Statistik, n.d.). This highlights the significant impact of effective innovation management on performance, competitiveness, and job creation, while enabling comparison between the two groups.

Each one-hour interview was recorded, anonymized, and transcribed for detailed analysis. Using atlas.ti, a qualitative content analysis was conducted with a coding system based on five key areas from the interview guidelines. A total of 48 codes were applied, leading to the analysis of over 500 quotations.

4. Results

In this section, the interviews are analysed, and the most noteworthy statements are be highlighted to uncover insights from companies.

4.1 Innovation Strategy

Large companies see innovation as a strategic tool to extend product life cycles or adapt products, while small companies view it as a response to customer needs, often driven by close relationships. Some small firms use innovation strategically to differentiate rather than compete on price. Formal innovation strategies are common in large firms; small companies prefer flexible, hands-on approaches. Large companies reflect innovation's value through dedicated resources and turnover investment but risk viewing it mainly as development. Small companies focus more on innovation's external impact to boost market presence and customer engagement.

Interviews suggest large companies struggle to communicate innovation priorities due to complex hierarchies, while small companies find it easier as leadership works closely with employees. A large company noted: *"But the willingness to implement can sometimes be challenging... We're working on communicating this even more clearly."* Large firms use measurement tools to track product performance against business cases, whereas small companies rely more on intuition and customer feedback. One small company said: *"There was no analysis of why it did not succeed."* Some are beginning to value objective evaluation, with one manager stating*: "Since the last project was very extensive, various teams have realised that this should be done."*

4.2 Innovation Process

Innovation processes in Swiss companies differ significantly between large and small companies. Large companies use structured, standardized processes with some subsidiary flexibility, as one representative said: "*The process is the same for the entire company and all innovation projects. The goal is for each division to establish this process within its own process landscape."* Small companies use more informal, agile approaches but risk less strategic decisions. A small company manager noted: "*It is not a concrete process. It's more individual. ... To be honest, our process is not documented*." Another added: "*Structure, leadership, and control are a little lacking. If we have a good idea, we try it out. But it's not very systematized."*

Large companies typically use stage-gate processes with defined KPIs to manage risk and reduce sunk costs, often leading to incremental innovation. Smaller firms favour agile, pragmatic decision-making in regular team meetings, resembling informal design thinking. While smaller companies maintain close ties with customers and suppliers, they engage external partners less formally. In contrast, large firms actively collaborate with startups, suppliers, and universities to enhance innovation.

4.3 Innovation Structure

In both large and small Swiss companies, innovation responsibility is clearly assigned, with smaller firms relying more on personal initiative. All interviewees felt accountable, highlighting the recognized importance of innovation. Employee involvement in innovation differs notably. Small companies engage everyone to leverage diverse team input. Large companies vary: some focus on specific teams, others encourage bottom-up ideas. One large company said, "*We don't start strategic projects top-down. We let them grow from the bottom*," while another noted, "*You never reach everyone. It remains a challenge*." Involvement depends on company structure and views on employee contributions.

4.4 Innovation Culture

Both small and large companies value openness, diversity, and employee input. Large companies are moving from conservatism toward embracing feedback, while smaller ones emphasize diverse teams and idea-sharing.

Resistance to new ideas exists in both, driven more by company age and industry than size, young companies behave differently from older ones. Learning from mistakes is widely seen as vital, with failure accepted as part of innovation.

Workshops promote a growth mindset, though it's unclear how widely this is embraced by all employees. Large companies foster innovation via structured initiatives, workshops, and internal communities. Smaller companies use a decentralized approach, relying on employee responsibility and informal encouragement, as one representative said: *"It is promoted by the individual team leaders who discuss values and goals with employees. Innovation is assessed there, and it is also reinforced that employees should come forward with ideas."*

Large companies are generally satisfied with their innovation culture but face challenges balancing innovation with established processes. A large company said: *"One wishes that everyone could speak the language of the innovator... The question is often: new or tried and tested?"* Smaller companies, though content with their culture, feel they could speed up turning ideas into market-ready products. A small company noted: *"We come up with ideas and prototypes relatively quickly but actually finishing them and bringing them to market quickly is where we could improve."*

4.5 Innovation Management Tools

Large companies actively gather employee ideas through methods like pitch competitions and monthly innovation questions. However, these ideas often lack alignment with strategic goals. One representative noted: *"Idea management has been buried... We don't believe that innovation starts with ideas!"*

Small companies aim for structure but face challenges in idea collection; some use platforms like Jira, while others struggle with participation. Both small and large businesses agree monetary incentives don't drive innovation; recognition, awards, and feedback are preferred. All stress the importance of feedback on ideas and follow-up. Creativity methods are used situationally in both, without being overly emphasized.

5. Discussion

The interviews show that innovation management is important for all companies; however, many different approaches and structures exist. The results confirm both that innovation strategies are developed company-specifically and that significant differences exist between the approaches of large and small companies (Hugentobler et al., 2020). Large firms use innovation as a strategic tool, while small ones focus on customer needs and practical approaches over formal planning. This aligns with the strategic innovation elements identified in the literature, where strategy defines the required innovativeness, specific focus areas, and the type of innovation pursued (Birkenmeier & Brodbeck, 2020). Findings indicate that large companies often formalise these strategic dimensions, whereas smaller firms' strategies might emerge more organically from immediate market interactions and customer demands.

The findings on innovation processes align with the literature indicating that resource availability influences the innovation processes in large versus small businesses (Vakulenko, 2021). Large companies use their resources to establish formal and structured processes. While traditional Stage-Gate systems are still common, and literature points to hybrid Agile-Stage-Gate models as a way to balance control and flexibility (Cooper & Sommer, 2018), our study didn't find adoption of these hybrid models among the interviewed. Small companies are more used to agile processes due to their limited resources, which allow more flexibility, but can be less focused on the strategy (Desouza et al., 2009). The literature suggests that small firms are more in need of external help. In contrast, our results show that large firms engage external partners more formally and broadly than small companies (Schori & Roch, 2012). This highlights how companies' interaction with outside partners differs significantly by company size, rather than just their need for help. This distinction is important for understanding how open innovation principles, which focus on sharing knowledge (Chesbrough, 2006), are put into practice. A company's size affects how it formalizes collaborations, shaping their scope and nature.

Results confirm that the responsibility for innovation is clearly assigned. The involvement of everyone in small companies aligns with the literature, which also mentions broad participation (Link & Rees, 2017). The diverse approaches in large companies are noteworthy, with no single method dominating. (Edison et al., 2018) have also shown that methods such as intrapreneurship, internal ventures, and crowdsourcing were used. These diverse structural approaches also reflect the importance of enabling diverse skills and human resources to drive innovation within different organizational contexts.

In both large and small companies, the results and literature show that openness, diversity, and employee input are valued (Augsten et al., 2017). Interestingly, it is not only the company size influencing resistance to new ideas, but also the age of the company. There is a gap between literature and practice regarding embracing failure. The adoption is questioned by the interview partners, leading to the implication that fear of failure might still prevent risk-taking. Large companies use structured initiatives to cultivate their innovation culture, which can lead to tension between innovative ideas and established processes. Smaller firms use more informal and decentralized options to establish their culture, as shown in the literature (Schori & Roch, 2012).

Large companies often gather employee ideas but struggle to align them with business goals, raising doubts about the value of collecting many ideas. Small companies use idea collection tools but face low employee engagement, likely due to limited resources, as noted in the background reading. Both types occasionally use innovation management tools (IMTs), but small firms' challenges suggest a resource gap. Recognition and feedback have proven more effective than financial rewards in promoting innovation. Although IMTs broadly cover areas like identifying innovation potential, assessing customer needs, and tracking technological trends (Birkenmeier & Brodbeck, 2020), our findings show a primary focus on idea generation and collection, with difficulties linking ideas to strategy and maintaining employee involvement. This suggests a gap between the theoretical scope of IMTs and their practical use across different company sizes.

Based on our discussion, we propose the following framework:

Table 2

Framework Category	Large Companies	Small Companies
Innovation Strategy	• Often a strategic tool for product adaptation/extension. • More resources for formal, structured development, analysis, research, implementation can be complex. • Internal value reflected in resource allocation. Risk of viewing it as purely development effort. • Implement measurement tools, monitor performance vs. business case. • Challenge of clearly communicating priorities through complex hierarchies.	• Often led by customer needs rather than strategy. Flexible, hands-on approach common. • Less formal development likely due to limited resources. Communication and implementation are easier. • Focus on enhancing market presence and customer engagement. • Rely more on intuition/customer feedback, though some recognize the need for objective methods.
Innovation Process	• Structured, formalised, often standardised processes (e.g., Stage-Gate) across the organization. • Significant resources available yet require effective use. • Use of KPIs to minimise sunk costs, manage risk; often results in incremental innovation. • Actively seek formal input from partners (startups, suppliers, universities)	• Often informal, improvised, agile processes, less documented. Risk of less strategic investment decisions. • Resource-constrained. Can leverage external capacities like consultants, suppliers, and customers. • Pragmatic decision-making, often in regular team meetings. • Closer to customers/suppliers but engage them less formally.
Innovation Structure	• Clearly assigned responsibilities. • Varied approaches of team involvement. • Form: May struggle with rigidity. Often create dedicated structures to foster innovation.	• Clearly assigned responsibilities, often rely on personal initiative. • Team/Involvement: Difficulty forming diverse internal teams, tend to engage everyone across teams. Often include external participants. • More simple organisational structures likely.
Innovation Culture	• Cultivation is more challenging due to scale/hierarchy. They use structured initiatives (workshops, internal communities). • Shifting from conservative past, embracing feedback/challenge • Values: Openness, diversity, encouraging input valued. • Failures are seen as essential. Workshops used. Skepticism as to whether this mindset is widespread. • Generally satisfied but acknowledge challenges balancing innovation with established processes. Resistance can exist.	• Easier to shape culture due to management proximity, direct influence, leading by example. • Foster diverse teams, enable idea-sharing, openness. • Failures are seen as an essential part of the process. • Resistance can exist.
Innovation Management Tools (IMTs)	• Build internal competencies. Can develop tools/methods tailored to the company. Creativity methods used situationally. • Idea Management: Use various approaches yet ideas often lack strategic alignment; 'idea management' itself is occasionally questioned. • Monetary incentives are ineffective; recognition, appreciation and feedback are preferred and more impactful.	• Often lack internal expertise. May rely on external consultants or simpler methods. Creativity methods used situationally. • Idea Management: Trying structured collection but facing participation challenges. • Monetary incentives are ineffective; recognition, appreciation and feedback are preferred and more impactful.

6. Conclusion

Findings show that innovation is important to both large and small companies, with clear responsibility assigned. However, their approaches differ. Large companies use structured processes but struggle with internal communication and aligning employee ideas with strategy. Small companies are more flexible and client-driven, fostering innovation through intuition but risk inefficiencies due to a lack of formal processes and evaluation. Innovation culture is easier to shape in small firms, while large companies face tension between innovation and established processes. To improve, large companies should adopt more agility, and small ones more structured planning and evaluation.

This study has limitations, focusing on only 6 small and 6 large Swiss companies in the German-speaking region. Still, it offers valuable insights into innovation management. Future research could include all company sizes and regions of Switzerland, expand the sample, and use longitudinal studies to track innovation management over time.

Ethics Statement

This research followed ethical principles to protect participants' privacy. Informed consent was obtained in advance, and all names were anonymized and coded to ensure confidentiality. No identifying information was disclosed, and all established ethical guidelines were strictly followed.

AI Statement

No artificial intelligence (AI) tools were used to conduct the research, analyse data, or generate findings presented in this paper. Any AI assistance was limited to supporting tasks such as translation, grammar and style refinement during the writing process. The integrity of the research methods and analysis is human driven.

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What Drives Venture Studios Success? Uncovering Successful Configurations in the European Landscape

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Abstract: This study investigates the emerging phenomenon of Venture Studios, organizations that systematically create and launch multiple startups, operating as "startup factories". While their global presence has expanded significantly, academic research on Venture Studios, and particularly on the factors driving their success, remains limited. In fact, existing literature has primarily focused on comparing Venture Studios to established Entrepreneurial Support Organizations (ESOs) and analysing their heterogeneity. To address this research gap, this study employs Qualitative Comparative Analysis (QCA) to identify the configurations of factors that lead Venture Studios to success. Leveraging a publicly available Venture Studio database and a funnelled sampling strategy, our analysis focuses on 25 European Venture Studios founded between 2009 and 2014. Building upon theoretical sampling, we examine configurations arising across five critical conditions influencing their performance at micro, meso, and macro level: founders' entrepreneurial experience, industry specialization degree, external affiliation, international orientation, and geographic positioning within entrepreneurial ecosystems. The outcome, Venture Studios success, is defined as the ratio of successful exits achieved by a studio's startups divided by its lifetime. Our results reveal four distinct configurations leading to Venture Studio success, confirming the heterogeneity of Venture Studios, and finding that multiple pathways to performances. Previous founding experience emerges as a predominant condition, appearing in three of the four successful configurations and never being absent. Also, a compensatory relationship between specialization and location is observed, suggesting that deep domain expertise can offset geographical disadvantages and that generalist studios can leverage their advantageous positioning. These results contribute to the literature on entrepreneurial support organizations and portfolio entrepreneurship by conceptualizing Venture Studios as an institutionalized form of portfolio entrepreneurship. The study provides also actionable insights for aspiring founders, investors, and policymakers, emphasizing the importance of considering interdependent factors for Venture Studio development and success.

Keywords: Venture Studios, Portfolio Entrepreneurship, QCA, Configuration Analysis, Exit Ratio Performance

1. Introduction

This study examines the emerging phenomenon of Venture Studios, organizations that systematically create and launch multiple startups simultaneously (Baumann et al., 2018; Patel and Chan, 2024). In 2022 industry reports suggest the existence of 560 Venture Studios worldwide, with a rapid growth over the previous years (Celen, 2022). Despite growing interest in practice, academic research on Venture Studios remains limited, particularly as what drives venture studios success. In fact, existing literature has primarily compared Venture Studios to established entrepreneurial support organizations (ESOs) (Kreusel et al., 2018; Rijnsoever, 2022) like accelerators, incubators and venture capital firms, and analysed the heterogeneity of Venture Studio as an emerging model (Moiana et al., 2024). Moreover, Venture Studios represent a novel case of portfolio entrepreneurship – entrepreneurs that manage multiple independent ventures concurrently (Iacobucci, 2002; Iacobucci and Rosa, 2005; Ucbasaran et al., 2008). However, while the heterogeneity of Venture Studios in terms of design choices is acknowledged (Moiana et al., 2024; Patel and Chan, 2024), the specific configurations of elements that contribute to their success remain underexplored. To address this research gap, this study employs Qualitative Comparative Analysis (QCA), with the aim of uncovering the complex interplay of factors contributing to the success of Venture Studios (Fiss, 2011; Ragin, 2008a).

In particular, leveraging on portfolio entrepreneurship and ESOs literature, our research examines five critical conditions influencing Venture Studios performance across micro, meso, and macro dimensions.

At the micro level, Venture Studios founder experience is considered a key determinant of venture performance (Stuart and Abetti, 1990). This condition reflects accumulated entrepreneurial expertise manifested through enhanced capabilities in opportunity recognition and resource acquisition across multiple ventures (Gruber et al., 2008). At the meso level, Venture Studios are shaped by distinct design choices that are expected to influence

their performance outcomes (Moiana et al., 2024; Patel and Chan. 2024). Drawing on existing literature, three key organizational conditions are identified: industry specialization, institutional affiliation, and international orientation. Industry specialization facilitates systematic knowledge accumulation and resource optimization (Pog, 2023). Formal institutional affiliations provide structured access to industry knowledge and intellectual property resources (Hamida and Gustafsson, 2020). Finally, a born global orientation enhances innovative capacity through cross-border knowledge acquisition, consistent with learning-by-exporting mechanisms documented in international entrepreneurship literature (Del Sarto et al., 2021). Lastly, at the macro level, geographic positioning within prominent entrepreneurial ecosystems potentially catalyses development through access to investment capital (Mason and Brown, 2014).

A rigorous sampling strategy was adopted to select 25 Venture Studios founded between 2009 and 2014, ensuring both case comparability and an adequate time horizon for outcome assessment. Our analysis reveals four distinct configurations for success: (1) "Affiliated Expertise ", combining formal institutional affiliation with substantial founder entrepreneurial experience; (2) "Domain-Specific Expertise", where industry specialization and founder experience compensate for non-prominent geographic positioning; (3) "Globally Oriented Niche Strategy", characterized by sector specialization and international orientation without ecosystem affiliation or prominent location; and (4) "General Global Expertise", leveraging founder experience, prominent ecosystem advantages and a born global orientation, while maintaining geographic diversification.

These findings contribute to the ESOs (Bergman and McMullen, 2022) and portfolio entrepreneurship literature (Baert et al., 2016; Santamaria, 2022) by conceptualizing Venture Studios as an institutionalized manifestation of portfolio entrepreneurship. Moreover, this analysis not only highlights the fundamental role of founder experience, which is present in three of the four successful configurations, but also offers a configurational contribution by identifying distinct pathways to success. Specifically, the compensatory relationship between specialization and location is uncovered, showing how these factors interact to drive successful outcomes across different Venture Studio configurations.

2. Literature Review

2.1 Venture Studios as New Actors in Entrepreneurial Ecosystems

Venture Studios represent an innovative organizational form within entrepreneurial ecosystems, characterized by the systematic creation and development of multiple ventures simultaneously. These entities repeatedly build companies by providing comprehensive resources and services, generating ideas internally and spinning off successful concepts into independent companies (Blank, 2022; Sansone et al., 2023). The model originated with Idealab in 1996, established by Bill Gross, and has experienced particularly rapid growth during the 2010s, with estimates suggesting the existence of over 560 studios worldwide as of 2022 (Celen, 2022).

Venture Studios promise several key advantages in the entrepreneurial landscape: (i) to reduce risk through portfolio diversification (Szigeti, 2019); (ii) to generate higher returns through larger equity stakes (typically 20-80%) compared to traditional investment models (Abreu, 2021; Coelsch-Foisner et al., 2024); (iii) to provide hands-on support from ideation to spin-off, facilitating serial entrepreneurship through repeatable processes, thus allowing for greater efficiency and scalability in venture creation (Köhler and Baumann, 2016; Szigeti, 2016).

Despite these significant promises, Venture Studios face distinctive challenges including equity distribution balancing, team dynamics management, addressing capital requirements, and differentiation in an increasingly competitive market (Abreu, 2021; Moiana et al., 2024).

2.2 Venture Studios as an Evolution of Portfolio Entrepreneurship

Portfolio entrepreneurship – the simultaneous ownership and management of multiple businesses by a single entrepreneur or entrepreneurial team (Westhead and Wright, 1998) – provides a theoretical foundation for understanding Venture Studios. This entrepreneurial approach enables individuals to distribute risk, leverage resources across ventures, and capitalize on diverse opportunities (Iacobucci and Rosa, 2010; Westhead et al., 2005). Venture Studios employ structured and repeatable processes for ideation, validation, and scaling of new ventures (Blank, 2022; Moiana et al., 2024; Patel and Chan, 2024). They can establish predefined pathways for venture exits and operate under formalized organizational structures that include dedicated teams for various stages of venture development and shared support functions across portfolio companies (Clarysse et al., 2011;

Köhler and Baumann, 2016). From a resource-based perspective, portfolio entrepreneurs create synergies by strategically sharing and reconfiguring resources and capabilities across their venture portfolios (Barney, 1991; Wiklund and Shepherd, 2008). This process of resource orchestration is particularly critical for maximizing value creation across multiple ventures (Santamaria, 2022; Sirmon et al., 2011). Venture Studios can leverage resource orchestration in venture ideation, validation and launching, utilizing centralized pools of human capital, technological infrastructure, and specialized resources that benefit multiple ventures simultaneously (Baert et al., 2016; Köhler and Baumann, 2016). Organizational learning theory further explains how portfolio entrepreneurs transfer knowledge between ventures, creating accelerated learning cycles (Argote and Miron-Spektor, 2011; Baert et al., 2016). Venture Studios adopt a systematic approach to new business ideation and validation across their portfolios. Successes and failures gained from one venture directly inform the development of others, creating a compounding effect that influences the likelihood of subsequent venture success. Finally, according to portfolio theory, portfolio entrepreneurship should mitigate risk by the means of diversification (Lechner and Leyronas, 2009; Westhead et al., 2005). The ability to redeploy resources across ventures within the portfolio further optimizes performance by facilitating timely exits from underperforming ventures while reinforcing successful initiatives (Santamaria, 2022).

2.3 Venture Studios Success Factors

Venture Studios' primary success metric is their capacity to effectively spin off independent ventures, culminating in successful portfolio ventures exits through IPOs or trade sales (Blank, 2022; Moiana et al., 2024; Pahnke et al., 2023). Building upon portfolio entrepreneurship and ESOs literature, five theoretically grounded conditions that potentially influence performance heterogeneity among Venture Studios are identified.

First, founder experience can enhance opportunity recognition and resource mobilization ability (Gruber et al., 2008; Hsu, 2007; Stuart and Abetti, 1990).

Second, specialization in particular domains enhances resource orchestration capabilities by enabling more efficient knowledge transfer between related ventures (Baert et al., 2016), and creates economies of scope in venture development, allowing studios to develop synergies (Santamaria, 2022).

Third, affiliation – formal institutional relationships with external entities – represents a structured extension of portfolio entrepreneurs' informal relational networks (Wiklund and Shepherd, 2008). These affiliations provide studios with institutionalized access to industry knowledge, legitimacy signals, and resource pathways (Adler and Kwon, 2002; Florin et al., 2003).

Fourth, born global orientation – manifested through ventures established across multiple countries – can enhance innovation through knowledge arbitrage across markets while mitigating dependency on single economic environments (Del Sarto et al., 2021).

Finally, location within established entrepreneurial ecosystems provides structured access to specialized financial capital, domain expertise, and supporting infrastructure (Audretsch and Lehmann, 2005; Spigel, 2017).

These conditions interact through complex configurational relationships rather than operating as isolated variables (Du and Kim, 2021; Leppänen et al., 2023; Pahnke et al., 2023). This perspective necessitates methodological approaches that can accommodate causal complexity, conjunctural causation, and equifinality – acknowledging that multiple distinct configurations may lead to equivalent outcomes (Fiss, 2011). Building upon the theoretical foundation and this configurational perspective, this study aims to address the question: "What configurations of factors contribute to the success of Venture Studios in their venture creation and development processes?"

3. Data and Methodology

The study employs fuzzy-set QCA (fsQCA), that is particularly suited for investigating configurational questions and complex causal relationships in small-to-medium sample sizes (Ragin, 2008a). fsQCA enables the assessment of multiple conjunctural causation, recognizing that combinations of conditions generate the outcome and that a given condition may have different impacts depending on context (Ragin, 2014).

The primary data source used to collect the data instrumental for the analysis is the Venture Studio Index Database, compiled by James Moran, containing information on 407 Venture Studios and 1,844 associated startups (Patel and Chan, 2024).

A funnelled sampling strategy was employed. First, the analysis was limited to European Venture Studios, reducing the dataset to 140 entities. Second, based on industry-led insights (Pog, 2023), we selected a nine year time horizon for assessing venture outcomes such as exits or sustained growth. As such, only those studios founded in or before 2014 were included, narrowing the sample to 56 cases. To ensure comparable macroeconomic conditions, only studios founded between 2009 and 2014 were included, resulting in a final selection of 46 cases. A final verification step confirmed alignment with established Venture Studio definitions (Diallo, 2015; Hamida and Gustafsson, 2020; Lawrence, 2019; Szigeti, 2019, 2017) through triangulation of data from websites, LinkedIn, Orbis, and PitchBook. This process yielded a final dataset of 25 verified Venture Studios.

3.1 Outcome: Venture Studio Success

This research defines success as the ratio of the number of exits achieved by a Venture Studio's startups divided by its lifetime (till 2023). This productivity-based metric was selected as the most appropriate measure for evaluating Venture Studios' performance for several reasons.

First, as "startup factories", Venture Studios' primary function is to systematically create, develop, and exit ventures (Scheuplein and Kahl, 2017). The exit rate per time unit directly captures this production efficiency analogous to manufacturing productivity metrics. Second, this measure standardizes performance across studios of different ages, allowing for meaningful comparisons between newer and more established entities. Third, unlike alternative metrics such as total funding raised or number of portfolio companies, exits represent definitive validation of venture value creation (Pahnke et al., 2023).

Data collection involved a rigorous multi-source verification. Initial exit data came from the Venture Studio Index and was cross-checked against archived 2023 studio websites via the Wayback Machine, focusing on portfolio exit sections. When websites lacked exit details, acquisition or IPO events were examined using Pitchbook's "Deal History" and Crunchbase's "Exits" sections. Each identified exit underwent validation by reviewing startup profiles on Pitchbook and Orbis, particularly the "Ownership Structure" and "Shareholder History" section, to confirm studio equity positions and divestitures. Additional validation included press releases and news articles. Inclusion in the dataset required confirmation from at least two independent sources, in order to ensure data reliability.

3.2 Conditions: success factors

Our research identifies five key conditions influencing Venture Studio success within a multi-level theoretical framework. Table 1 illustrate data collection process and calibration.

- **Founder experience:** Founder experience is quantified as the average number of prior entrepreneurial ventures per founder, representing accumulated human capital that enhances opportunity recognition and strategic decision-making.
- **Affiliation:** Affiliation is treated as a binary condition, reflecting formal institutional connections established at the Venture Studio's founding.
- **Specialization:** Specialization is categorized into three distinct tiers – generalist, broad vision, and highly specialized – based on each studio's initial strategic orientation, directly influencing their capabilities in resource orchestration and knowledge transfer.
- **Born global:** The born global condition measures the ratio of startups established internationally relative to the total portfolio, capturing the Venture Studio's international orientation.
- **Location:** Finally, location is categorized into six clusters derived from global entrepreneurial ecosystem rankings (Genome, 2024), recognizing structural advantages offered by prominent startup environments.

The calibration process for each condition followed established theoretical and methodological standards specific to QCA. Detailed operationalization, calibration parameters, and primary data sources are presented in the following table.

Table 1: Data Collection Process and Calibration

Outcome/Condition	Formula	Sources Used	Calibration
Success	[Equation]	Venture Studio Index database, Studio's website (Wayback Machine), PitchBook ("Deal History"), Crunchbase ("Exits"), Orbis ("Ownership Structure", "Shareholder History")	X ≥ 0.33 → 1 0.22 < X < 0.33 → 0.67 0 ≤ X ≤ 0.22 → 0.33 X = 0 → 0
Affiliation	Affiliated Not Affiliated	Venture Studio Index database, Studio's website (Wayback Ma-chine, founding year)	Affiliated → 1 Not Affiliated → 0
Specializa-tion	Highly Specialized General Vision Generalist	Studio's website (Wayback Machine, founding year), LinkedIn	Highly Specialized > 1 General Vision > 0.4 Generalist > 0
Born global	#portfolio startups [Equation]	Studio's website, Pitchbook ("Portfolio"), Startup's website ("legal notes," "terms and conditions," "privacy policy"), Orbis	X ≥ 0.25 → 1 0 < X ≤ 0.25 → 0.6 X = 0 → 0
Founder Experience	[Equation] en- [Equation]	Studio's website (Way-back Machine), Orbis ("People"), Pitchbook ("Team"), Crunchbase ("People"), LinkedIn	X ≥ 3 → 1 2 ≤ X < 3 → 0.85 1 ≤ X < 2 → 0.60 X < 1 → 0
Location	Cluster 1, Cluster 2, Cluster 3, Cluster 4, Cluster 5, Cluster 6	Studio's website ("legal notes", "terms and conditions", "privacy policy")	X = 1 → 1 X = 2 → 0.8 X = 3 → 0.6 X = 4 → 0.4 X = 5 → 0.2 X ≥ 6 → 0

4. Results

The first stage of our fsQCA investigation involved examining whether any single condition or combination of conditions is necessary for Venture Studios success following established methodological protocols (Ragin, 2008b; Schneider and Wagemann, 2012). The analysis revealed the absence of strictly necessary conditions or combinations of conditions for Venture Studio success. Our sufficiency analysis, instead, revealed four distinct configurations that lead to Venture Studio success (Figure 1).

- **Configuration 1: Affiliated Expertise.** This configuration combines affiliation with founder experience as core conditions. Exemplified by Antai and eFounders, this configuration demonstrates how institutional connections and entrepreneurial expertise create synergistic environments favourable to successful exits. These studios leverage established networks to access resources while deploying experienced-based judgment to navigate venture development effectively.
- **Configuration 2: Domain-Specific Expertise**. This configuration features specialization, founder experience, and non-prominent location. Hanse Ventures illustrates this configuration, having achieved multiple successful exits despite operating outside primary entrepreneurial hubs. Their specialized competencies in the digital sector, combined with significant founder experience, effectively counterbalance potential geographic limitations.
- **Configuration 3: Globally Oriented Niche Strategy.** This configuration is characterized by sector specialization and born-global orientation, coupled with the absence of ecosystem affiliation and prominent location. Fast Lane Ventures exemplifies this path, having succeeded through deliberate specialization in both industry focus and geographic strategy despite lacking institutional affiliations or prime ecosystem positioning.
- **Configuration 4: General Global Expertise.** This configuration combines born-global orientation, substantial founder experience, and prominent location, paired with non-specialization. ICEO Venture Builder typifies this configuration, having achieved numerous successful exits across diverse sectors

through a globally oriented approach enabled by experienced leadership and advantageous ecosystem positioning.

	Solution			
	1	2	3	4
Structure				
AFFILIATION	●		⊗	
SPECIALIZATION		•	•	⊗
FOUNDER EXPERIENCE	●	•		•
BORN GLOBAL			•	●
LOCATION		⊗	⊗	●
Consistency	0.917	1.000	0.930	0.877
PRI	0.896	1.000	0.794	0.825
Raw Coverage	0.280	0.150	0.087	0.181
Unique Coverage	0.117	0.094	0.087	0.056
Overall Solution Consistency	**0.947**			
Overall Solution PRI	**0.931**			
Overall Solution Coverage	**0.574**			

Figure 1: Venture Studio success' configurations

Beyond the four configurations, we identify two cross-configurational patterns. First, founder experience emerges as a predominant condition, appearing in three of the four configurations and never showing as absent. Notably, the only configuration lacking founder experience exhibits the lowest Proportional Reduction in Inconsistency (PRI) and raw coverage values among all solutions, indicating its comparative weakness. This pattern underscores the substantial influence of entrepreneurial experience on Venture Studio performance.

Second, we can observe a systematic complementarity between specialization and location. This relationship suggests a strategic trade-off between domain expertise and geographic advantage. Studios with deep domain specialization appear capable of overcoming locational disadvantages through their concentrated expertise, while generalist studios can leverage their advantageous positioning in munificent entrepreneurial ecosystems to leverage a richer pool of resources. The analysis also identified one deviant consistency case, M33, which contradicts the sufficiency principle. Despite demonstrating membership in the sufficient configuration set, M33's didn't have success in terms of the metric used in this research. Further investigations revealed that this apparent contradiction may stem from alternative success metrics aligned with M33's parent company (Theodo), whose strategy could favour integration rather than exit.

5. Discussion

The obtained results reveal four distinct pathways to Venture Studio success, demonstrating that multiple configurational arrangements can lead to effective venture exit outcomes (Fiss, 2011). These findings contribute to the evolving understanding of Venture Studios in two significant ways.

First, our results empirically confirm the heterogeneity of Venture Studios previously identified in conceptual and descriptive studies (Coelsch-Foisner et al., 2024; Moiana et al., 2024; Sansone et al., 2023). As Cohen et al. (2013) emphasize in their analysis of accelerators, there exists "substantial variation" in program design and implementation approaches. This study advances this understanding for Venture Studios by demonstrating that this heterogeneity extends also to success pathways. The identified configurations vary significantly in their constituent elements, reflecting diverse strategic approaches to venture creation and development. This heterogeneity aligns with the principles of equifinality in entrepreneurial contexts, where multiple paths can lead to equivalent outcomes (Del Sarto et al., 2021; Fiss, 2011; Ragin, 2008a).

The configurations can be categorized into dominant and non-dominant pathways based on their core conditions and empirical relevance. Configurations 1 and 4 represent dominant pathways characterized by core conditions – those appearing in both parsimonious and intermediate solutions. These configurations

demonstrate stronger empirical evidence through higher coverage values, indicating their broader explanatory power across the studied cases. Configurations 2 and 3, instead, represent non-dominant pathways with peripheral conditions that contribute to success in specific contexts. These insights further underscore the heterogeneity of the Venture Studio model and empirically demonstrate that the principle of equifinality perfectly applies, confirming that different configurations can lead to successful outcomes for Venture Studios.

Second, our findings highlight the central role of founder experience in Venture Studio success. Present in three of four configurations and absent in none, entrepreneurial experience emerges as a critical factor that transcends other organizational characteristics. This predominance of founder experience aligns with established entrepreneurship literature emphasizing experiential knowledge as a key determinant of venture performance (Abreu, 2021; Wiklund and Shepherd, 2008) and suggests that Venture Studios represent an institutionalized form of portfolio entrepreneurship. In fact, while traditional portfolio entrepreneurship typically operates through individual entrepreneurs managing multiple ventures informally (Iacobucci and Rosa, 2010), Venture Studios formalize this process through organizational structures and systematic approaches, while focusing in supporting new ventures 'first mile'. Therefore, the Venture Studio represents an hybrid form (between a founder, supporter, and investor) that systematizes entrepreneurial processes while remaining fundamentally dependent on experiential knowledge (Moiana et al., 2024; Patel and Chan, 2024).

For practice, these results offer insights for different stakeholders. For aspiring Venture Studio founders, our findings emphasize the critical importance of prior entrepreneurial experience. For investors, our configurations provide a framework for evaluating Venture Studio potential – encouraging the evaluation of interdependent factors rather than relying on a mere checklist logic. For policymakers, the interplay between specialization and ecosystem positioning suggests that successful Venture Studio development does not hinge only on prominent entrepreneurial ecosystems. Instead, Venture Studios can foster place-based entrepreneurship in more rural areas through regional development strategies.

6. Limitations and Conclusions

Our study is not free from limitations. First, the use of fsQCA involves critical choices regarding set calibration and consistency thresholds, significantly impacting outcomes (Ragin, 2008b). Second, the causal complexity that characterize the Venture Studio model suggests other explanatory conditions may have been neglected. Third, our research relies on the presence entrepreneurial exits to measure success. This metric may overlook other value dimensions, such as exit value, job creation, innovation, or sustainability impact (Abreu, 2021). Broader success metrics could enrich understanding of Venture Studios. Future research should replicate this study in different contexts, and with different conditions, to identify other success configurations. Additionally, examining unsuccessful configurations, leveraging fsQCA's ability for analysing negative outcomes (Greckhamer et al., 2018), could yield valuable insights. Despite these limitations, the study represents a first attempt to understand the performances determinants of the heterogeneous phenomenon of Venture Studios, adopting a configurational logic.

AI Declaration

AI tools were utilized exclusively for the purpose of language enhancement, including assistance with grammar, spelling, sentence structure, and clarity. The authors retain full responsibility for the accuracy, originality, and intellectual content of the final paper.

Ethical Declaration

This research did not require ethical clearance as it did not involve human participants, personal data, or any activities requiring formal review under institutional guidelines.

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When Lean Startup Meets Complex Societal Problems: Challenges in Startup Early-Stage Experimentation

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Abstract: In today's rapidly evolving entrepreneurial landscape, addressing complex societal challenges, or has emerged as a crucial area of focus for startups. On the other hand, startups are often encouraged to adopt experimental lean approaches, which emphasize focusing on a customer problem and developing hypotheses to envision a viable value proposition and business model. However, while lean methodologies prioritize quick iterations and scalability, they may fall short when tackling complex issues that require long-term commitment, collaboration across diverse stakeholders, and careful consideration of societal impact. The study's research question is centred on understanding how lean startup approaches can be applied to engage with stakeholders, pivot, and iterate their business models based on feedback received from various actors. To explore this, we select the mobility industry in Italy as the empirical setting for this study. Italy's urban mobility landscape presents a unique and complex context, characterized by a growing need for sustainable transport solutions, the presence of public and private sector collaboration, and the active role of diverse actors working to address these challenges. We employ an exploratory multiple-case study approach, examining five startups addressing mobility-oriented problems. A total of 13 in-depth interviews were conducted in two waves. Data was triangulated with secondary sources, such as podcasts, whitepapers, and press releases, to understand the stakeholder dynamics involved in the experimentation phase. Our findings suggest that: (i) startups typically begin with broad, ambitious goals, only to pivot toward more narrowly focused problems, thereby reducing the scope of their initial ambitions; (ii) startups addressing more complex problems tend to find support from public entities, while those focused on less wicked problems prioritize direct engagement with end-users and industry experts, as the lean startup approach suggests. Moreover, by adopting as an analytic device the three main categories derived from the lean Impact startup framework (value search, value creation, and value distribution), we identify specific challenges faced by entrepreneurs in the first two stages of the process. The study concludes by offering practical insights into how entrepreneurs can better navigate the complexities of stakeholder engagement when tackling wicked problems.

Keywords: Lean Startup; Societal Challenges; Wicked Problems; Experimentation

1. Introduction

In the contemporary landscape of innovation and entrepreneurship, addressing complex societal challenges has become a focal point for researchers and practitioners alike (George et al., 2011). These problems are also known as "wicked problems," i.e. difficult to define, have no clear solution, and are deeply interconnected with other problems. Wicked problems, a term first coined by Rittel and Webber (1973), require innovative approaches and frameworks that go beyond traditional problem-solving methods.

On the other side, startups have emerged not only as engines of economic growth and technological advancement but also as potential vehicles for addressing these intricate societal challenges, as they make them particularly suited to exploring new solutions where established organizations may struggle to act (George, Schillexcbeeck and Marril, 2021; Filippelli, Troise, Bigliardi, & Corvello, 2025).

The rapid evolution of the business landscape, characterized by technological advancements and ever-changing market dynamics, has necessitated the adoption of innovative methodologies by entrepreneurs and organizations (Ghezzi, 2019). The Lean Startup Approach (LSA), developed by Eric Ries and Steve Blank, is one such approach that has drawn a lot of interest (Ries, 2011; Blank, 2023). To validate value propositions and business models, LSA places a strong emphasis on iterative experimentation and customer-centricity as a learning strategy to reduce uncertainty (Cavallo & Ghezzi, 2020).

However, a critical gap remains in our understanding of how LSA can be applied to contexts defined by wicked problems and societal grand challenges. While LSA has proven effective in many contexts, extending its principles to address wicked problems presents unique challenges and opportunities. Wicked problems necessitate an understanding of unintended consequences, interconnected sub-problems, and the perspectives of diverse stakeholders (Alford & Head, 2017).

By adopting an exploratory multiple case study design (Eisenhardt & Graebner, 2007; Yin, 2003), this research investigates how startups in the mobility industry implement the Lean Startup Approach (LSA) in response to stakeholder feedback. The mobility sector offers a particularly fertile ground for this exploration, as it embodies many of the characteristics associated with challenges that are interdependent, context-specific, and involve a multiplicity of actors with conflicting interests, rendering conventional solutions insufficient or even counterproductive.

By adopting the social LSA framework as analytical device (Bacq & Wang, 2024), this study contributes to the literature in three ways: (i) it examines how entrepreneurs in the mobility sector identify and shape new business opportunities with an explicit environmental or social mission (i.e., value search); (ii) it investigates how startup strategies evolve in response to stakeholder engagement and the feedback derived from interactions with users, partners, institutions, and communities (i.e., value creation); (iii) it investigates how measurable or perceived improvements in relation to the wicked problems at stake (i.e., value distribution).

We aim to enrich the understanding of how the Lean Startup Approach (LSA) is applied in wicked contexts, where the problems entrepreneurs seek to address are deeply intertwined with complex societal challenges. Ultimately, we seek to inform both theory and practice on how experimentation and feedback loops can be mobilized not only to build viable businesses, but also to generate broader societal value.

2. Theoretical Background

2.1 Wicked Problems

The concept of *wicked problems* emerged in the late 1960s to describe complex societal challenges that resist traditional problem-solving approaches (Rittel & Webber, 1973; Skaburskis, 2008). Introduced by Rittel and Webber in their seminal work *Dilemmas in a General Theory of Planning*, wicked problems are characterized by features: wicked problems lack a definitive formulation; understanding the problem is itself part of the problem-solving process. They have no stopping rule, meaning that one never knows when a solution is "good enough," and no objective test of solution validity – solutions are judged subjectively as better or worse depending on stakeholders' values and perspectives. Importantly, each attempted solution is a “one-shot operation” with often irreversible consequences. Moreover, wicked problems are inherently unique, context-specific, and often symptoms of other problems, forming a network of interdependent issues (Rittel & Weber, 1973; Alford & Head, 2017).

In this context, entrepreneurship is increasingly recognized as a key vehicle for engaging with wicked problems. Entrepreneurs operate in uncertain, dynamic environments and are often able to craft novel value propositions that address social and environmental challenges. Recent work calls for equipping individuals with the mindset and capabilities of "wicked scientists"– those trained to tackle the ambiguity, complexity, and interdependence of modern grand challenges (Moritz & Kawa, 2022).

One promising entrepreneurial response involves the development of context-specific strategy tools. Burke and Wolf (2020) show how the process of *toolmaking* – i.e., crafting ad hoc strategic frameworks – can help managers and entrepreneurs navigate wicked problems. These tools, rather than providing fixed solutions, facilitate sensemaking, experimentation, and continuous adaptation to shifting stakeholder environments.

2.2 Lean Startup Approaches

The Lean Startup methodology has become a cornerstone in the study and practice of entrepreneurship because it offers a disciplined, experimentdriven path through high uncertainty (Shepherd & Gruber, 2020). Rooted in Ries’s Lean Startup and Blank’s Customer Development, the approach revolves around five tightly linked routines: (1) articulating falsifiable hypotheses about the venture’s core assumptions and ordering them by risk; (2) embedding these hypotheses in a provisional businessmodel design that specifies how the venture might create, deliver, and capture value; (3) building a *minimum viable product* (MVP) that is just elaborate enough to test the riskiest assumptions; (4) engaging “earlyvangelists” to generate rapid, qualitative and quantitative feedback; and (5) iterating through a disciplined *persevere–pivot–perish* decision loop. Recent scholarship extends this logic beyond purely commercial goals. Bacq and Wang (2024) propose a *Lean Impact Startup* framework that marries Lean experimentation with contemporary stakeholder theory, positioning iterative learning as a means to surface and negotiate social and environmental value claims. This

suggests that entrepreneurial mindsets, digital tools, and collaborative stakeholder engagement can be mobilised to tackle wicked problems in agile and scalable ways.

Our study asks: "How do lean impact entrepreneurs approach stakeholder engagement during different stages of the experimentation process?" By focusing on this question, we aim to deepen scholarly understanding of how LSA principles are reinterpreted in contexts where stakeholder feedback is not just a means for validating value propositions and business models, but a critical input for achieving lasting societal impact.

3. Methods

This study adopts a qualitative, exploratory research design grounded in a multiple case study approach (Eisenhardt, 1989; Yin, 2009). We decided to adopt these methods due to the contemporary, complex, and context-dependent nature of the phenomenon of interest (Gartner & Birley, 2002). Case studies enable in-depth exploration of processes within real-world settings and are particularly well-suited for theory-building in emerging or under-explored domains (Eisenhardt & Graebner, 2007).

We selected the urban mobility sector as an empirical setting. Urban mobility issues intersect with environmental concerns, infrastructure constraints, evolving regulatory frameworks, and diverse stakeholder needs, making it a fertile ground for studying stakeholder engagement within LSA. The sector also represents a dynamic context of digital transformation, where emerging technologies are increasingly deployed to reimagine smart cities.

A heterogeneous sampling strategy was employed to capture variation across technological domains (hardware and software startups). The focus has been on digital startups with innovative solutions. This criterion ensured that the selected startups were leveraging cutting-edge technologies and methodologies, aligning with the research's emphasis on innovative approaches to tackling wicked problems in the mobility sector. Lastly, the selection process targeted startups that explicitly utilized Lean Startup principles. This requirement was emphasized in all engagement emails sent to potential participants. Ensuring that the selected startups adhered to LSA was essential for exploring how these principles are applied in real- world scenarios to validate and pivot MVPs based on stakeholder feedback. The use of Lean principles is a key aspect of the research, as it aligns with the goal of understanding iterative development processes in addressing complex, multifaceted problems.

The unit of analysis is related to the evolution of value proposition and the business model of 5 startups (see table 1). Primary data were collected through 13 in-depth, semi-structured interviews with key informants, including early-stage startup founders and industry experts. These informants were selected for their direct involvement in or observation of stakeholder engagement practices during entrepreneurial experimentation. The interviews were designed to probe the rationale, strategies, and perceived outcomes of stakeholder interactions at different stages of the Lean Startup cycle (Gioia, Corley, & Hamilton, 2012). Interview guides were informed by themes from the literature review and organized into sections aligned with the research framework. All interviews were recorded, transcribed verbatim, and coded for further analysis. To enhance data triangulation and strengthen the validity of the findings (Denzin, 1978), secondary data sources were also integrated, including company whitepapers, press releases, public interviews (e.g., podcasts and conference talks), and media coverage. These materials provided contextual insights that helped to situate and interpret the interview data more robustly.

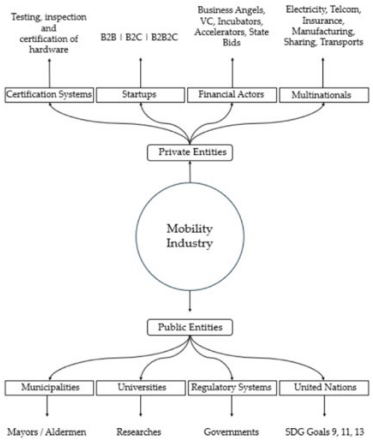


Figure 1: Mobile industry stakeholder mapping

The data analysis followed a Grounded Theory-informed inductive coding approach (Gioia et al., 2012). Coding proceeded in several iterative rounds (figure 1). In the first phase, in vivo codes were generated to remain close to participants' language and meaning. These were then synthesized into higher-order conceptual categories using constructed codes developed by the research team. Following Eisenhardt and Graebner's (2007) logic of replication, each case was treated as a standalone analytical unit, and both within-case and cross-case analyses were performed to identify patterns of convergence and divergence.

The coding process led to the emergence of three overarching categories that map onto and extend the Lean Impact Startup framework (Bacq & Wang, 2024):

1. *Value Search* – how stakeholder input shaped initial problem framing and hypothesis formulation;
2. *Value Creation* – how feedback informed MVP development and iterative experimentation;
3. *Value Distribution* – how entrepreneurs engaged stakeholders in co-defining long-term impact and inclusivity goals (not the focus of the article).

These categories offered a structured understanding of how stakeholder engagement practices evolve throughout the experimentation process and how they inform the pursuit of lasting social impact within entrepreneurial settings.

Table 1: Case selection

Case	Description	Year of Foundation	Solution Type	Type of Primary Stakeholder	Active Cities
Case A	Pioneering startup specializing in innovative urban mobility solutions with smart parking systems using IoT technology	2021	Hardware	B2B	3
Case B	Mobile energy solutions startup specializing in on-demand mobile battery recharging for electric vehicles	2021	Hardware	B2B	2
Case C	Digital platform company dedicated to simplifying urban parking through advanced technology solutions	2021	Software	B2B, B2C, B2G	104
Case D	Technology company specializing in streamlining business onboarding processes through AI and ML algorithms	2019	Software	B2B, B2G	10
Case E	Technology company focused on revolutionizing transportation through advanced vehicle-sharing platform	2018	Software	B2B, B2C, B2G	6

4. Findings

This research examines urban mobility startups to understand how they navigate stakeholder engagement during different stages of development. Startups were clustered based on the complexity (wickedness) of the problems they address and whether they produce hardware (higher complexity) or deliver digital services (lower complexity).

The analysis focuses on two primary dimensions derived from the Lean Impact Start-Up Framework: *Value Search* and *Value Creation*. Furthermore, the analysis was carried out in two phases: the first identified key stakeholder categories (Figure 1), and the second explored which challenges arise in the value search and creation steps (Table 2).

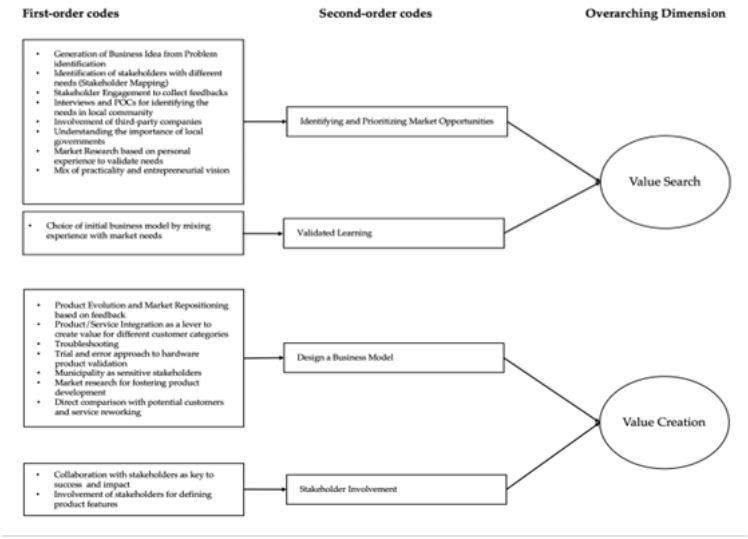


Figure 2: Data Structure

4.1 Value Search

According to the Lean Impact Startup framework, the value search phase encompasses two core activities: stakeholder discovery and stakeholder validation. Our analysis reveals that this phase is shaped by two critical dimensions: the *complexity of the problem* being addressed – reflected in the number and diversity of stakeholders – and the *complexity of the product* (hardware vs. software).

The complexity of the problems significantly influenced the categories of stakeholders involved. Startups addressing higher degrees of complexity, such as Startup D and Startup E, engaged with a broader range of actors, including public entities, local administrations, and private sector partners. This extensive engagement was essential for understanding the multifaceted nature of the urban mobility challenges they aimed to solve. However, practical insights from users and market analysis led to a significant shift. As Startup A founder explained: *"We realized that starting with city models was not feasible due to complexity. Instead, we needed to begin with a more controlled environment",* he explained. This shift involved focusing on long-term parking solutions in the initial phase and gradually expanding to include short-term parking and other services.

For instance, Startup D engagement with local transport agencies highlighted the significant impact of local administrations in shaping urban mobility solutions. The founder stated: "*We realized that the role of local administrations in some cities is quite substantial*." This engagement with multiple stakeholder groups was crucial for gaining a comprehensive understanding of the problem context. Similarly, Startup E collaborated with various players, including car dealerships and insurance groups, to validate their initial concept and streamline operations. Startup E's founder emphasized, "*We started with vehicles from dealerships because starting directly with private vehicles involved complexities*".

In contrast, startups addressing lower degrees of problem complexity, such as Startup A and Startup B, focused more on industry experts and potential users. For these startups, the stakeholder discovery process was more targeted, involving direct engagement with industry stakeholders to validate the feasibility of their future prototypes. Startup A's founder, initiated the process by engaging with potential users and industry experts at smart mobility fairs, which revealed the need to integrate parking sensors with electric charging stations. The founder noted, "*With a big corporate, they first brought up the issue, asking if we had considered connecting the sensor to electric columns*". The complexity of the products developed also influenced the stakeholder discovery process. Hardware-focused startups like Startup A and Startup B, dealing with more sophisticated and costly solutions, emphasized early validation with industry experts to minimize spending and ensure feasibility of the development of their prototype. On the other hand, software-focused startups such as Startup C, Startup D, and Startup E started with a more detailed stakeholder mapping and thorough market analysis. For these startups, the market is full of possible consumers and/or people that bring interests to the future solution, making stakeholder mapping and feedback analysis essential. For instance, the founder of Startup C conducted comprehensive market research and stakeholder mapping, beginning with private parking operators and expanding to public parking authorities. The founder highlighted, "*I mapped out the stakeholders, starting with*

private parking operators who were more responsive to this type of approach, gradually moving to more complex stakeholders like public parking authorities".

In conclusion, the value search process is deeply contingent on the complexity of the problem and the type of product being developed. Startups adapted their stakeholder discovery and validation strategies accordingly – ranging from focused expert consultation to broad institutional engagement – highlighting the need for context-sensitive approaches in the early stages of innovation.

4.2 Value Creation

The value creation phase marks a shift from exploring where to play to defining how to win – that is, how startups develop viable, desirable, and feasible solutions with key stakeholders. While all startups recognized the importance of stakeholder engagement in value creation, the nature and depth of this engagement varied substantially depending on the *complexity of the problem* and of the *solution*.

Startups developing hardware-based solutions, such as Startup A and Startup B, centered their value creation efforts on early-stage technical prototyping and validation with experts and 'early evangelists'. These actors played a critical role in shaping the product's functional specifications. Startup B's founder, emphasized the importance of rapid iteration: *"Validating the idea is complex, especially when that validation requires hardware... we put up a fully functioning prototype within three months."* Similarly, Startup A pivot from a standalone app to a fully integrated sensor system emerged through close feedback loops with municipalities and infrastructure providers. Founder Andrea Buri explained, "*We approached a lot of customers… to understand whether having an extra app on the citizen's phone was really useful".*

In contrast, startups developing software-based solutions – like Startup C, Startup D, and Startup E – that faced more complex problems, required multi-stakeholder engagement across institutional, commercial, and user domains. These startups placed greater emphasis on stakeholder integration throughout the value creation process. For instance, Startup D adopted what the founder called an 'artisanal approach', deliberately avoiding mass communication to engage in-depth with core stakeholders. This allowed for the co-design of modular features tailored to diverse urban contexts.

The complexity of the solution directly influenced the scope and intensity of stakeholder involvement. Hardware startups tackled relatively bounded, though technically challenging problems, allowing for concentrated engagement with domain experts. For example, Startup A responded to feedback from a big utility's corporate to ensure their sensors could support real-time monitoring of charging station parking: "*We have a contract with a big corporate for installations… the user will know if the parking lot is free or occupied."*

On the other hand, software startups operated within more ambiguous, socially entangled problem spaces, requiring iterative stakeholder mapping and negotiation. Startup C had to balance the expectations of public authorities, private parking operators, and end users – each shaping different layers of the solution. Startup D highly abstract architecture emerged precisely to accommodate this diversity, as the founder explained: *"We created a solution with such a level of abstraction that it can succeed with different data sources but deliver the same value."*

In summary, value creation in urban mobility startups is shaped by the interplay between product complexity and problem complexity. Hardware startups pursued tightly scoped, expert-driven experimentation to refine technical reliability. Software startups, by contrast, embraced broader, iterative stakeholder integration to navigate complex, multi-actor systems. In both cases, stakeholder co-creation emerged as essential.

5. Discussion

This study investigated how LSA is applied by entrepreneurs who engage stakeholders across different phases of the experimentation process, particularly when addressing wicked problems (Rittel & Webber, 1973).

Our study in the context of urban mobility startups hihglights that stakeholder engagement is not peripheral but central to experimentation in contexts marked by high uncertainty, and systemic interdependencies. Startups operating in wicked domains must continuously navigate feedback from diverse stakeholder groups – including public institutions, private actors, and end-users. This supports prior claims that innovation under grand challenges requires collaborative and adaptive approaches (Ferraro, Etzion, & Gehman, 2015). However, we go further by showing how the complexity of the problem and of the solution influence stakeholder engagement. A core insight of this study concerns the differentiated stakeholder strategies between hardware

and software startups, reflecting structural differences in experimentation dynamics. Hardware ventures, constrained by high capital intensity and longer development cycles, tend to frontload engagement with domain experts and infrastructure partners to ensure technical feasibility before broader scaling. In contrast, software startups benefit from shorter iteration cycles, enabling ongoing feedback integration and adaptive responses to stakeholder.

Our findings support the growing view that Lean Startup principles – when adapted – offer valuable mechanisms for tackling wicked problems (Bacq & Wang, 2024). However, doing so requires entrepreneurs to develop contextual sensitivity, especially in calibrating experimentation according to the nature of the technology (physical vs. digital), stakeholder number and type, and institutional environment.

Finally, we acknowledge that this study is exploratory in nature and is based on a limited number of cases, which constrains the generalizability of our findings. Future research could build on these insights by employing a larger and more diverse sample of startups, as well as designing the case selection to better control variance ex ante. Moreover, longitudinal studies could further illuminate how stakeholder engagement strategies evolve over time, particularly in response to technological maturation, regulatory shifts, and changing stakeholder dynamics. Comparative analyses across industries facing different types of wicked problems could also refine our understanding of how experimentation strategies interact with contextual complexity.

AI Declaration

AI tools were utilized exclusively for the purpose of language enhancement, including assistance with grammar, spelling, sentence structure, and clarity. The authors retain full responsibility for the accuracy, originality, and intellectual content of the final paper.

Ethical Declaration

This research did not require ethical clearance as it did not involve human participants, personal data, or any activities requiring formal review under institutional guidelines.

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Entrepreneurship Ecosystems: The Gardener Metaphor

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Abstract: This paper proposes a novel framework for understanding entrepreneurship ecosystems (EEs) through the gardener metaphor, integrating complexity theory, distributed leadership, and institutional design. Drawing on empirical insights from Manizales Más in Colombia and grounded in a design-driven, hermeneutic methodology, the metaphor reimagines EEs as dynamic, cultivated environments requiring strategic vision, adaptive care, and collaborative effort. Key components of EEs—markets, culture, human capital, public policy—are mapped onto garden elements like plants, soil, pollinators, and fertilizers. The gardener becomes a symbol of ecosystem leadership, moving beyond individualistic or laissez-faire approaches to emphasize stewardship, design, and resilience. This narrative framework bridges abstract theory and actionable strategy, offering scholars and practitioners a fresh, integrative lens for cultivating entrepreneurial ecosystems. This research contributes to the broader discourse on EEs by providing an accessible yet robust conceptual model that bridges the gap between abstract theory and practical application. The metaphorical framework enhances understanding and decision-making for policymakers, ecosystem developers, and researchers, emphasizing the importance of holistic, adaptive, and inclusive approaches to entrepreneurship support. Through this work, I invite readers to explore the intricate beauty and challenges of cultivating entrepreneurship ecosystems, drawing inspiration from the natural world to inform sustainable and impactful development.

Keywords: Entrepreneurship Ecosystem, Complexity Theory, Design, Institutional Leadership, Narrative Metaphor

1. Introduction

Entrepreneurship ecosystems (EEs) are complex networks of interconnected actors, resources, and institutions that foster innovation, economic growth, and entrepreneurial success (Isenberg 2010). Over the years, scholars and practitioners have increasingly turned to metaphors to describe these ecosystems, (Pilinkienė & Mačiulis 2014) drawing parallels with biological systems to capture their dynamic and interdependent nature. However, these metaphors often stop short of exploring the intricate processes and relationships that sustain and challenge these ecosystems in practice.

This paper proposes an expanded metaphor: the entrepreneurial ecosystem as a garden. Gardens, much like ecosystems, require careful cultivation, diverse elements working in harmony, and constant adaptation to changing conditions. By extending the biological analogy, this metaphor emphasizes the roles of intentionality, stewardship, and resilience in fostering thriving entrepreneurial environments.

The inspiration for this metaphor emerged during my work with Manizales Más, a regional entrepreneurship ecosystem in Colombia (Molina & Maya 2018). Observing the intricate interactions between its stakeholders—entrepreneurs, policymakers, educators, and investors—I recognized similarities with the processes and elements found in natural ecosystems. Discussions with thought leaders like Daniel Isenberg and insights from value ecology literature further shaped this perspective, revealing the critical need to consider both cooperation and competition in building sustainable EEs.

Using a design-driven methodology that combines theoretical inquiry with empirical observations, this paper unpacks the gardener metaphor to provide a practical framework for understanding and nurturing entrepreneurship ecosystems. Key questions guide this exploration: What is a garden made of? Who is the gardener? What about the weeds? Through these questions, the paper seeks to reframe the way we think about EEs, offering insights into their composition, the roles of various actors, and the challenges they face.

By bridging art, science, and practice, this work contributes a novel perspective to the discourse on EEs. It highlights the importance of intentional design, collaboration, and adaptability in fostering sustainable entrepreneurial growth, providing value to scholars, practitioners, and policymakers alike.

2. Background

During my doctoral research and close collaboration with the Manizales Más entrepreneurship ecosystem, I became intrigued by the potential of expanding the biological metaphor often associated with entrepreneurial ecosystems (EEs). While the term "ecosystem" inherently suggests a biological analogy, I realized that the

richness of natural symbolism offers untapped potential to explain the complex elements and relationships that define EEs.

A pivotal moment in shaping this perspective occurred during a conversation with Daniel Isenberg at the ZERI Pavilion in Manizales. Reflecting on his role in fostering entrepreneurial ecosystems globally, he remarked that his work was akin to scattering seeds: “Sometimes it falls on concrete, sometimes it falls on water, sometimes it falls on great land and an ecosystem flourishes.” While his words highlighted the randomness and variability inherent in ecosystem development, they left me unsettled. I found myself frustrated and even disheartened, as his description seemed to overlook the nuanced interactions and sustained efforts of the agents actively cultivating these ecosystems.

This frustration prompted me to delve deeper into the theoretical underpinnings of ecosystems. A key insight came from Den Ouden (2011), who emphasized the holistic and dynamic nature of value creation in ecosystems, highlighting a "competitive and cooperative environment in which members create value in different roles." This perspective clarified my discomfort: the contributions of the many actors within the ecosystem, which I witnessed firsthand in Manizales Más, were being overshadowed by a reductionist view of ecosystem development.

Inspired by this realization, I began exploring the parallels between natural ecosystems, such as gardens, and entrepreneurial ecosystems. Through iterative modelling processes, the metaphor of the gardener began to take shape. This metaphor offers a lens through which to understand EEs, blending theoretical and empirical insights with a deductive yet speculative approach. It also reflects the interdisciplinary nature of design, which seamlessly combines art and science to make complex systems comprehensible.

This paper addresses three central questions to unpack the gardener metaphor: What is a garden made of? Who is the gardener? And what about the weeds? These questions frame an exploration of the components, roles, and interactions within entrepreneurial ecosystems, culminating in a holistic understanding of their dynamics, growth, and challenges.

3. Theoretical Framework: Complexity, Leadership, and Metaphor

3.1 Complexity and Adaptive Systems

Complexity theory challenges linear, input-output models of innovation by emphasizing emergence, feedback loops, and adaptation (Berkes et al., 2003; Uhl-Bien et al., 2007). Entrepreneurship ecosystems, in this view, function as socio-technical systems where agents co-evolve with their environments, responding to both endogenous interactions and exogenous shocks.

3.2 Distributed and Institutional Leadership

Leadership within ecosystems is rarely centralized. Instead, it is distributed across actors who perform complementary roles—policy champions, institutional entrepreneurs, ecosystem weavers. Uhl-Bien and Marion (2009) define such leadership as the process by which adaptive outcomes are generated in conditions of interdependence. This paper argues that ecosystem "gardeners" are archetypes of such leadership—curating, cultivating, pruning, and intervening strategically.

3.3 Metaphor as Method

Metaphors help make sense of complexity by offering heuristic analogies that draw on familiar domains to explain abstract or systemic ones (Lakoff & Johnson, 1980; Schön, 1983). The garden metaphor extends biological and ecological analogies common in EE discourse but goes further by emphasizing intentionality, aesthetics, and care—values often underrepresented in economic modelling. Following Dorst (2015), this metaphor was developed through a design-based, abductive process blending empirical observation with speculative reasoning.

4. Methodology: A Hermeneutic-Design Approach

This research adopts a hermeneutic and design-based methodology informed by grounded theory principles. The data source was long-term immersion in the Manizales Más ecosystem, including interviews, design workshops, and stakeholder dialogues conducted between 2016 and 2020. The metaphor of the gardener emerged as a way to synthesize complex findings and communicate them effectively to both academic and practitioner audiences.

Rather than test hypotheses, the goal was to construct a metaphorical model capable of generating insights, guiding action, and provoking reflection. This is aligned with speculative design methods (Auger, 2013) that use narrative and symbolism to reframe problems and imagine alternative futures.

5. What Constitutes a Garden?

To answer the question "What is a garden made of?" one might immediately think of plants, soil, pollinators, fertilizers, seedbeds, water, gardening tools, and migrating animals. In the context of entrepreneurial ecosystems, these elements correspond respectively to markets, culture, human capital, public policy, support entities, finance, administration, and external relationships. This section develops the analogies between the essential elements of a garden and the core components of an entrepreneurial ecosystem. The full metaphorical framework will be unveiled in Section 4, where the gardener metaphor is presented in its entirety.

Let us now explore how this analogy unfolds into a cohesive metaphor:

5.1 Plants: Markets

In this metaphor, the market dimension of an entrepreneurial ecosystem is represented by plants. Plants encompass all kinds of enterprises, from the nascent business idea—akin to a seed that requires careful nurturing before planting—to the towering tree, symbolizing a mature firm integrated within a forest-like entrepreneurial network. The diversity of plant species mirrors the variety of sectors, while their size signifies different stages of business development.

A seed evolves into a plant, then a tree, and eventually becomes part of a forest, much like a business idea progresses to a business model, then to a firm with defined capabilities, and ultimately integrates into an entrepreneurial ecosystem. A balanced garden requires both youthful energy, represented by seeds and young plants, and the stability provided by mature trees, which offer shade and enrich the soil, fostering a conducive environment for future growth.

Entrepreneurial ecosystems like Manizales Más are not vast forests but rather dynamic, diverse gardens capable of nurturing various agents. This diversity underscores the interplay between new ventures and established businesses, which together form a thriving market.

5.2 Soil/Substrate: Culture

Soil symbolizes the cultural dimension of an entrepreneurial ecosystem. Just as soil consists of organic and inorganic components, culture comprises tangible and intangible elements that foster entrepreneurial behaviour and perception. The inorganic aspects of soil represent pre-existing cultural traits intrinsic to a location—elements often taken for granted. The organic components, on the other hand, embody the dynamic aspects of culture, such as entrepreneurial gatherings, collaborative initiatives, and networks that transform and enrich the ecosystem over time.

A robust entrepreneurial culture acts as fertile soil, enabling diverse agents to collaborate effectively toward shared objectives. While the inherent attributes of a location might be favourable for entrepreneurship, it is the organic, transformative interactions within the culture that ultimately determine the soil's capacity to support sustained entrepreneurial growth.

5.3 Pollinators: Human Capital

Pollinators, essential for the fertilization of flowers and the production of seeds and fruit, represent the human capital dimension of the ecosystem. In nature, pollinators include bees, wasps, butterflies, and even small

mammals. Within entrepreneurial ecosystems, these correspond to professors, mentors, advisors, peer entrepreneurs, and institutions like universities.

A garden with a rich variety of pollinators thrives through cross-pollination, enhancing plant growth and productivity. Similarly, a diverse and vibrant pool of human capital fosters learning, sharing of best practices, and collaborative innovation. Professors, mentors, and advisors play distinct but interconnected roles—much like bees and butterflies—ensuring the ecosystem's sustained vitality and success.

5.4 Fertilizers: Public Policy

Fertilizers, which enrich soil and enhance plant growth, parallel the role of public policy in entrepreneurial ecosystems. Fertilizers, such as potassium, phosphorus, and nitrogen, gradually transform soil composition to strengthen plants. Similarly, public policies—such as entrepreneurship laws, support projects, and tax incentives—can significantly impact the ecosystem's development. These policies act as layers of topsoil, providing essential nutrients and protection.

Effective public policy fosters entrepreneurship by creating favourable conditions for business growth. Conversely, detrimental policies can strip the ecosystem of vital nutrients, leading to stagnation or decline, much like a neglected garden where plants wither and die.

5.5 Seedbeds/Greenhouses: Support Entities

Seedbeds and greenhouses correspond to the support entities dimension of entrepreneurial ecosystems. Seedbeds provide controlled environments with nutrient-rich soil to nurture young seedlings, while greenhouses shield vulnerable plants from harsh external conditions. Analogously, support entities—such as chambers of commerce, accelerators, incubators, and entrepreneurship networks—offer structured programs and resources to help nascent businesses develop capabilities and survive their initial stages.

These entities function as safe spaces where entrepreneurs receive guidance, training, and resources, enabling them to transition from fragile startups to robust enterprises capable of thriving within the broader ecosystem.

5.6 Water: Finance

Water represents finance within the ecosystem. Water is vital for nutrient transport and physiological processes in plants, just as financial resources are essential for business operations and growth. In a garden, watering systems range from simple hoses to advanced sprinklers, depending on the size and complexity of the garden. Similarly, financial resources vary from personal loans and microcredits to angel investors and venture capital networks.

The financial needs of a business depend on its stage of development and sector. Startups typically require frequent injections of capital for growth, while established firms may seek larger, targeted investments for expansion or innovation.

5.7 Gardening Tools: Administration

Gardening tools symbolize the administration dimension of the ecosystem. Basic tools, such as shovels and rakes, address the needs of small gardens, while larger gardens may require wheelbarrows, ladders, or even chainsaws for complex tasks. Similarly, entrepreneurial ecosystems demand administrative structures appropriate to their scale and complexity.

From boards of directors to program managers, effective administration ensures that resources are allocated efficiently and that diverse agents within the ecosystem work harmoniously toward shared goals.

5.8 Migrating Animals: External Relations

Migrating animals, which traverse vast distances in search of better conditions, represent the external relationships of entrepreneurial ecosystems. These animals include investors, researchers, and advisors who temporarily engage with the ecosystem, bringing fresh perspectives, resources, and opportunities.

In the case of Manizales Más, external relationships have included collaborations with institutions like Babson College and MIT, as well as insights from thought leaders like Daniel Isenberg. These interactions enrich the ecosystem by introducing innovative ideas and fostering global connections.

6. Who is the Gardener?

The gardener plays a vital role in shaping and nurturing the entrepreneurship ecosystem. Much like a gardener carefully plans and tends to their garden, an effective ecosystem architect envisions the desired end result, designs the framework, and cultivates the various elements that will work together to achieve that vision. The gardener's role, much like that of a designer, is crucial in the process of ecosystem development.

6.1 The Gardener that Just Spreads the Seed Around

Some view the gardener as a "sower" who casts seeds widely, hoping for the best. This approach is similar to the parable of the sower: some seeds will thrive, while others may falter. In the context of entrepreneurship ecosystems, this perspective aligns with a more laissez-faire, seasonal crop farming approach—where the focus is on planting many seeds (i.e., fostering many ideas or startups) and hoping that some of them grow into successful ventures. This type of gardener is focused on the quantity of seeds planted rather than the specific care each plant needs.

6.2 The Gardener Working for Curbside Appeal

This type of gardener is focused on improving the exterior, making the garden inviting for outsiders. In the entrepreneurship ecosystem, this could represent efforts to enhance the attractiveness of a region or market to potential investors, businesses, and talent. It’s about creating an appealing environment that draws people in, often by highlighting the best aspects of the ecosystem, even if that means focusing more on aesthetics than on the internal growth processes.

6.3 The Gardener Who Dreams with a Topiary

The gardener who envisions a topiary—a sculptural, artistic arrangement of plants—is one who is deeply invested in the long-term process. This gardener is careful and strategic, selecting the right plants, soil, fertilizers, and tools, and considering the environment in which the topiary will flourish. Like a designer who maps out every detail, this gardener is attuned to each aspect of the ecosystem and understands the time, patience, and tools required to create a carefully shaped and sculpted space. In entrepreneurship terms, this gardener represents the thoughtful, long-term strategist who builds a robust ecosystem by considering the nuanced interplay of all its components.

6.4 The Versailles Gardener

The Versailles garden, one of the most remarkable in the world, took decades to create, requiring the work of countless people, designers, engineers, and gardeners. This metaphor draws a parallel to the creation of an advanced, successful entrepreneurship ecosystem—one that is planned meticulously but also allows for natural growth and interactions. Just as Versailles integrates various spaces—greenhouses, flower beds, large tree forests, and fountains—an ideal entrepreneurship ecosystem combines infrastructure, resources, and spaces for innovation, fostering interactions and creating micro-ecosystems within the broader system. This type of gardener ensures that all elements of the ecosystem work in harmony, from the larger framework to the smallest details, creating a thriving environment where growth can happen organically and sustainably.

Each of these gardeners, whether they are sowing seeds widely, focusing on the outward appearance, shaping topiaries, or planning grand, interconnected landscapes, brings a unique approach to the creation and cultivation of an entrepreneurship ecosystem. The role of the gardener is integral in ensuring that the ecosystem has the right conditions to thrive.

7. What About the Weeds?

In any entrepreneurship ecosystem, there can be challenges that hinder growth, much like weeds in a garden. Weeds represent unwanted businesses or ventures that may emerge in the ecosystem, often due to

misallocation of resources or unintended investments. These weeds can crowd out the plants (entrepreneurs and startups) that were intentionally nurtured. Examples of weeds might include:

- **Unsustainable businesses**: Companies that rely on short-term gains without a solid business model, often causing market instability or leading to wasteful investment.
- **Overly competitive ventures**: When too many businesses with similar, unoriginal ideas compete for the same resources, causing market saturation without contributing to innovation or diversity.
- **Fraudulent or exploitative ventures**: Scams or unethical businesses that may thrive in a poorly regulated environment, diverting resources and attention away from legitimate entrepreneurs.

These are just a few of the unwanted elements that can emerge in an ecosystem. Much like a gardener who must remove weeds without harming the plants, an ecosystem architect must find a balance between addressing negative influences (the weeds) and fostering healthy growth. In the context of entrepreneurship, this means using the right tools, such as regulations, public policy, and administrative measures, to shape the ecosystem and remove harmful elements without stifling innovation.

The tools used by the gardener (administrator or policymaker) are essential in creating a conducive environment for growth. These tools allow for the careful regulation and nurturing of the ecosystem, ensuring that it remains healthy and focused on supporting the desired growth. In the same way that a gardener uses fertilizer, pruning tools, or selective weeding to maintain the balance, public policy and administration act as the tools that keep the entrepreneurship ecosystem clear of obstacles while encouraging innovation. With the right care and attention, the ecosystem can evolve into the kind of landscape envisioned—whether that be a topiary, an oasis, a thriving forest, or even a masterpiece like the Versailles Garden.

8. The Gardener Metaphor Turning into the Tale of a Gardener

Creating an entrepreneurship ecosystem is akin to planting a garden. The first step is to define the size, the look, and what type of plants you'd like to cultivate. As I reflect on this metaphor, I am transported into a tale of a gardener. I imagine being a gardener in the mid-17th century, tasked with the monumental responsibility of shaping a vast piece of land into what would become one of the most beautiful and opulent gardens in the world—The Versailles Garden.

Every garden begins with a desire to create something special—whether it's a green space, a flowery spot, or just a place that offers more than the mundane expanse of grass in front of your house. But what we don't always understand initially is the immense thoughtfulness that goes into the process. The gardener is faced with the challenge of turning barren land into something extraordinary, and this requires careful planning. Where will people walk? What kind of soil is available? How will water be directed throughout the space? What kind of care will the plants require to survive the changing seasons? And most importantly, how can all of this please a king who desires a legacy built on opulence?

Some might call me obsessive, but my curiosity led me to learn more about the Versailles Garden and its chief gardener, André le Nôtre. Coming from a family of gardeners, he had a vast knowledge of plants and soil, but what truly struck me was that he also studied arts, mathematics, and architecture. This combination of expertise helped him design a garden that wasn't just beautiful but also functional, a place where nature met artistry. Le Nôtre's design made full use of all available water sources and strategically played with light and shade. Shaded spaces were carefully balanced with brighter areas. The parterres and primary alleys were punctuated by statues and yew trees sculpted into stunning forms, which helped make Versailles famous for its topiary art. But le Nôtre never worked alone. As the chief gardener, he led an army of people, each with different roles, but all ultimately responding to his vision. While there were areas dedicated to topiaries, there were also forests, greenhouses, meadows, and grazing areas to manage. In this grand design, I see how diverse elements—each managed by different gardeners—can come together to create something magnificent.

Now, back in the 21st century, my dream is to foster entrepreneurship ecosystems as complex and beautiful as the Versailles Garden. These ecosystems would not thrive solely on exclusive advantages or on a large number of people working within a single industry. Instead, they would nurture and cultivate diversity. A place where a university student with an idea has the same opportunities as someone who has just retired and decides it's finally time to pursue that project they once abandoned. A place where large companies help smaller businesses grow.

In this vision, the flow of information, technology, and people creates a new wave of innovation and social well-being for all stakeholders—not just investors, but also local communities, workers, and all those who can contribute to an ever-evolving landscape of connections and transformation. My ideal entrepreneurship ecosystem is a social network that embraces new members, skills, ideas, and approaches, and achieves impressive results that go beyond financial measures. These results would include trust, collaboration, social impact, and overall well-being.

9. Conclusions About the Interactions, Blossoming, and Withering

This paper repositions the entrepreneurship ecosystem not as an emergent outcome of market forces alone, but as a deliberately cultivated and co-designed system that requires continuous care, adaptation, and systemic thinking. Drawing on the gardener metaphor, this study highlights the importance of intentional leadership, institutional alignment, and collaborative processes in fostering vibrant and resilient ecosystems. Adopting a gardener's mindset—one that balances planning with responsiveness—may prove particularly valuable for policymakers, educators, and ecosystem developers seeking to enhance entrepreneurial capacity in complex environments.

The metaphor yields several key insights:

- **Soil as Institutional Culture:** The fertility of the ecosystem is shaped by the level of trust and collaboration among institutions. Just as nutrient-rich soil supports plant growth, ecosystems rooted in strong institutional relationships provide a conducive environment for entrepreneurial activity.
- **Pollinators as Human Capital:** Mentors, educators, and advisors act as pollinators, facilitating the exchange of knowledge and catalysing growth. Their presence enhances cross-fertilization within the ecosystem, enabling faster and more robust entrepreneurial development.
- **Fertilizer as Public Policy:** Targeted, well-designed public policies enrich the ecosystem by enhancing its structural conditions. Much like fertilizer boosts plant growth, effective policies nourish ecosystem actors and align incentives for long-term value creation.
- **Seedbeds as Support Mechanisms:** Incubators, accelerators, and business support centers serve as controlled environments that nurture early-stage ventures. These seedbeds reduce vulnerability and prepare startups to thrive in more competitive, open conditions.
- **Water as Financial Capital:** Finance is essential for sustaining entrepreneurial initiatives. Like water, it must be appropriately distributed—responsive to both the scale and phase of enterprise development—to prevent stagnation or over-saturation.
- **Tools as Administrative Infrastructure:** Effective administration provides the operational tools required to sustain ecosystem activity. From governance structures to management practices, these tools ensure alignment, coordination, and execution across actors and initiatives.
- **Migrating Animals as External Linkages:** External stakeholders—such as international investors, diaspora entrepreneurs, or global thought leaders—can inject fresh perspectives and resources. Their temporary yet strategic engagements can significantly alter the ecosystem's trajectory.
- **Control and Uncertainty:** The gardener must discern between controllable variables (e.g., seedbeds, water systems) and those beyond their influence (e.g., migratory flows, macroeconomic shifts). Resilience lies in managing the former while adapting to the latter.
- **Admiration vs. Understanding:** Just as gardens may be admired without appreciation for the labour behind them, entrepreneurship ecosystems are often celebrated without full recognition of the invisible, continuous work required to design, sustain, and evolve them.
- **Lifecycle and Regeneration:** Ecosystems, like gardens, require ongoing maintenance, periodic renewal, and structural adaptation. Over time, some elements will need to be replaced, redesigned, or phased out to maintain systemic health and relevance.

As Pilinkienė and Mačiulis (2014) remind us, each ecosystem analogy must be context-sensitive, reflecting its unique configuration of actors, interactions, and goals. The garden metaphor is not a universal model but a situated framework that highlights the co-evolutionary and cultivated nature of entrepreneurship ecosystems. While techniques and tools may be shared across ecosystems, their application and success will ultimately depend on local conditions, leadership vision, and the dynamic interplay among system components.

Future research may build on this metaphor by operationalizing its elements into evaluative frameworks, exploring its resonance across diverse cultural and institutional contexts, or examining its utility in guiding ecosystem interventions. As global challenges grow more complex, the demand for thoughtful, adaptive, and inclusive ecosystem cultivation becomes not only relevant—but imperative.

Ethics Declaration

This research did not involve human participants, animals, or sensitive personal data. Therefore, ethical clearance was not required. All sources used in the study have been appropriately cited, and the research adheres to academic integrity standards.

AI Declaration

AI tools were used in the preparation of this paper to enhance the coherence and clarity of the writing. As the author's primary language is Spanish, AI-assisted revision was applied to refine the style and ensure proper linguistic accuracy after translation. However, all intellectual contributions, analysis, and conclusions presented in this work remain solely the responsibility of the author.

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Industrial Organisation Analysis of the Mobile Market in Latin America

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L96, L13, L22, D43, L51

Abstract: This paper examines the structure and performance of the mobile telecommunications market in six Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico, and Peru. Drawing on industrial organisation theory, the study focuses on the degree of market concentration and the presence of oligopolistic dynamics. Key indicators—such as market share, the number of mobile lines per operator, and the Herfindahl-Hirschman Index (HHI)—are used to assess the competitive structure of each national market. The findings reveal consistently high levels of concentration across all six countries, with América Móvil and Telefónica emerging as dominant regional players. These multinational firms maintain a significant presence in multiple markets, reinforcing a pattern of regional consolidation. In Colombia, for instance, three operators—Claro, Movistar, and Tigo—control nearly the entire mobile market, highlighting the sector's oligopolistic nature and its implications for pricing, service quality, and innovation. The study employs a descriptive and quantitative methodology, using firm-level data and official reports from national regulators and organisations such as ECLAC. It also incorporates insights from the literature on strategic firm behavior and product differentiation to contextualise how dominant actors maintain market power. Despite the existence of regulatory frameworks aimed at fostering competition, the research finds that enforcement is often insufficient to curb concentration. Strategic behaviors—such as service bundling, infrastructure control, and aggressive marketing—allow dominant firms to entrench their position. This paper contributes empirical evidence on telecommunications market dynamics in emerging economies and calls for stronger regulatory mechanisms and regional coordination to promote fairer, more competitive, and inclusive digital markets.

Keywords: Mobile Telecommunications, Market Concentration, Latin America, Oligopoly, Industrial Organisation, Strategic Behavior

1. Introduction

The mobile telecommunications sector has become a strategic industry in Latin America due to its role in improving connectivity, fostering digital inclusion, and enabling economic development. Over the past two decades, the region has experienced a rapid expansion in mobile service coverage and mobile internet access, driven by technological innovation and increasing consumer demand. However, the market structure in many Latin American countries remains highly concentrated, with a small number of multinational operators dominating national markets.

This paper aims to examine the mobile telecommunications market in six Latin American countries—Argentina, Brazil, Chile, Colombia, Mexico, and Peru—through the lens of industrial organisation theory. It specifically investigates market concentration and strategic behavior, focusing on how dominant firms consolidate market power and the implications this has for competition and consumer welfare.

A central concern in the region is the presence of oligopolistic market structures. In most countries analysed, América Móvil and Telefónica are the two major players, with market shares that often exceed 60% when combined. This duopolistic dominance, along with limited effective competition, raises critical questions about market efficiency, innovation incentives, and service quality.

The regulatory environment is a key variable in this context. Although most countries have independent telecommunications regulators and legal frameworks intended to ensure fair competition, implementation and enforcement vary significantly. In some cases, regulations lag behind market dynamics, allowing dominant firms to exploit their position through bundling, predatory pricing, and control over infrastructure. Regulatory asymmetries, limited spectrum access for new entrants, and insufficient oversight of mergers and acquisitions further hinder competitive dynamics.

Existing literature has highlighted that high market concentration can lead to reduced incentives for innovation, higher prices, and lower service quality (Sung, 2014; Fawaz et al., 2021). Theoretical frameworks such as the Structure-Conduct-Performance (SCP) paradigm and Bertrand competition models with product differentiation are useful for analysing these dynamics. In this paper, we combine these frameworks with empirical analysis

based on market share data and the Herfindahl-Hirschman Index (HHI) to assess the level of competition in each country.

This introduction sets the stage for a comprehensive analysis of mobile telecommunications in Latin America, focusing on both structural issues and regulatory limitations. The goal is to provide evidence-based insights into the behavior of dominant firms and offer recommendations to strengthen regulatory frameworks and promote more competitive markets.

2. Literature Review and Theoretical Framework

The study of telecommunications markets from the perspective of industrial organisation provides essential insights into how market structure influences firm behavior and performance. In oligopolistic markets—characterised by a small number of dominant firms—strategic interaction becomes a key feature, as each firm's decisions affect and are affected by the behavior of competitors (Tirole, 1988; Lipczynski, Wilson, and Goddard, 2017).

2.1 Structure-Conduct-Performance Paradigm

The Structure-Conduct-Performance (SCP) paradigm, originally proposed by Bain (1959) and refined by Mason (1939, 1949), serves as a foundational framework for analysing the relationship between market concentration and firm behavior. According to this model, the structure of a market—defined by the number of firms, entry barriers, and degree of product differentiation—directly influences the conduct of firms, including pricing strategies, investment decisions, and innovation. This conduct, in turn, affects the overall performance of the market in terms of efficiency, consumer welfare, and innovation.

In the case of mobile telecommunications, high concentration levels—measured by indicators such as market share and the Herfindahl-Hirschman Index (HHI)—suggest reduced competition and potentially negative outcomes for consumers. Studies by Krstić et al. (2016) and Pereira and Vareda (2013) confirm the usefulness of HHI as a tool to evaluate market structure and define thresholds for regulatory intervention.

2.2 Strategic Behavior and Product Differentiation

Strategic behavior in oligopolistic markets includes product differentiation, pricing, advertising, and investment in infrastructure and innovation. Bertrand's competition model with product differentiation is particularly relevant in this context, as it assumes that firms compete on price while offering differentiated services (Belleflamme and Peitz, 2015). In Latin American mobile markets, differentiation strategies include bundling services (mobile, internet, TV), exclusive data plans, and brand positioning.

The behavior of firms like América Móvil and Telefónica illustrates how investment in innovation, aggressive marketing, and control over infrastructure can reinforce market dominance. According to Useche and Fernández (2008), these strategies often aim to restrict market entry and secure long-term consumer loyalty, thereby reducing the effectiveness of competitive pressures.

2.3 Market Power and Regulation

Market power refers to a firm's ability to set prices above competitive levels sustainably (Motta, 2004). In the telecommunications sector, regulatory frameworks are intended to limit this power and encourage fair competition. However, regulation in Latin America has not always been effective. Structural barriers, such as limited spectrum allocation and weak institutional capacity, undermine regulatory efforts and often result in asymmetries that benefit incumbent firms (Rubinfeld, 2015).

Authors like Bardey et al. (2022) argue that regulatory capture and the lack of regional harmonisation exacerbate these challenges. Although some countries have implemented reforms—such as spectrum auctions and pro-MVNO (Mobile Virtual Network Operator) policies—their impact remains uneven across the region.

In conclusion, the literature reveals a consistent concern with the interaction between market concentration, firm behavior, and regulatory effectiveness. The next section will describe the methodology used to evaluate these dynamics empirically across six Latin American countries.

Recent research highlights the need to complement traditional concentration measures, such as the Herfindahl-Hirschman Index, with broader institutional and strategic perspectives. For instance, Wang et al. (2008) examine

how technological homogeneity affects firms' innovation capabilities, offering insights relevant for understanding dominant behavior in oligopolistic markets. Similarly, Legault and D'Amours (2011) explore collective representation and institutional frameworks, emphasising the interplay between regulation and enterprise strategies. Upadhyaya (2015) contributes with a quantitative model approach, which reinforces the value of integrating operational and structural variables in market analysis. In the context of digital transformation and production systems, Hajarnavis (2021) discusses mobile access to industrial data, relevant for analysing competitive positioning in technologically dynamic markets. Environmental factors, such as those discussed by Ozkan and Uygur (2019), also reflect the growing importance of multidimensional assessments when evaluating industry performance and policy design. These contributions support a more integrated approach to the analysis of mobile telecommunications markets in Latin America, beyond simple concentration metrics.

To complement the literature review, a keyword co-occurrence network was constructed using bibliometric data. The analysis reveals thematic clusters in the academic discussion surrounding mobile telecommunications and industrial organisation. As shown in Figure 1, keywords such as "industrial organisation", "wireless telecommunication systems", and "industrial management" emerge as central nodes, indicating a strong intersection between technical systems, strategic behavior, and market structure. The clustering also highlights differentiated research streams, including regulatory frameworks, embedded systems, and network security. This visualisation supports the relevance and interdisciplinary nature of the present study.



Figure 1: keyword co-occurrence network

Keyword co-occurrence network of scientific publications on mobile telecommunications and industrial organisation. The size of each node represents keyword frequency, and colours indicate thematic clusters.

3. Methodology

This study adopts a descriptive and quantitative approach to analyse the structure and strategic behavior in the mobile telecommunications markets of six Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico, and Peru. The research is grounded in the industrial organisation framework, particularly the Structure-Conduct-Performance (SCP) paradigm and Bertrand competition models with product differentiation.

3.1 Data Collection

The data used in this study was collected from official sources, including national regulatory agencies, the International Telecommunication Union (ITU), and reports from the Economic Commission for Latin America and the Caribbean (ECLAC, 2022). The primary variables analysed include:

- Market share by mobile operator (percentage of total lines)
- Number of active lines per operator
- Herfindahl-Hirschman Index (HHI) as a measure of market concentration
- Entry of Mobile Virtual Network Operators (MVNOs)
- Regulatory indicators such as spectrum allocation, pro-competition policies, and presence of dominant firm regulation

The period of analysis spans from 2018 to 2023, ensuring comparability across countries and capturing recent structural changes in the sector, such as mergers, acquisitions, and regulatory reforms.

3.2 Measurement of Market Concentration

Market concentration is assessed through the Herfindahl-Hirschman Index (HHI), calculated as the sum of the squared market shares of all firms operating in the mobile telecommunications market of each country:

$$HHI = \sum_{i=1}^{n} S_i^2$$

where S_i is the market share of firm i . According to the guidelines of the U.S. Department of Justice and the European Commission, HHI values above 2,500 indicate high concentration, while values between 1,500 and 2,500 indicate moderate concentration.

This index is complemented with C1, C2, and C3 indicators, representing the cumulative market share of the top 1, 2, and 3 firms respectively, to better capture the dominance of key players.

3.3 Analysis of Strategic Behavior

Firm-level behavior is analysed through qualitative indicators based on service portfolios, pricing strategies, innovation efforts, bundling practices, and advertising campaigns. While detailed firm-level financials are not publicly available in all cases, publicly disclosed data from company reports and regulatory filings were used to assess strategic positioning.

In Colombia's case, the methodology also includes an exploratory estimation of firm performance and differentiation strategy using panel data from January 2022 to March 2024, as developed in previous fieldwork (Molina & Montoya, 2024). This includes monthly line data and revenue figures where available.

In highly concentrated mobile telecommunications markets, firms do not rely solely on price competition. Instead, they engage in strategic behavior to differentiate their services, create customer lock-in, and reinforce their market dominance. The most common strategic tools include:

- Product bundling (mobile, internet, TV, fixed line)
- Investment in network infrastructure and spectrum
- Aggressive advertising and brand loyalty programs
- Technological innovation (e.g., early 4G/5G deployment)
- Vertical integration (especially with fixed networks and wholesale services)
- This section highlights how these strategies manifest in each national market, based on public data, firm reports, and regulatory information.

3.3.1 Argentina

Claro and Movistar focus on bundling mobile services with broadband and entertainment content. Telecom Argentina (Personal) offers triple play and has integrated mobile and fixed services since its merger with Cablevisión. The strategic focus is on market segmentation through plan customisation and brand identity. Promotions often include free streaming, social media access, or zero-rated apps to retain subscribers.

3.3.2 Brazil

Vivo (Telefónica) employs a premium positioning strategy, emphasising quality, nationwide coverage, and innovation. It was among the first to roll out 5G services in major cities. Claro uses convergence with its cable operator (NET) and bundling as core strategies. TIM, now strengthened by acquiring Oi Móvel assets, leverages price segmentation and rural coverage expansion. All three invest heavily in advertising and user experience optimisation.

3.3.3 Chile

Firms in Chile adopt aggressive marketing and customer acquisition strategies. WOM, the newest major player, entered the market with a low-cost model and high-profile advertising campaigns, forcing incumbents to react. Entel maintains a strong local brand with extensive rural reach. Movistar and Claro compete by offering integrated plans and data-heavy bundles. Chile's pro-competition regulation has encouraged more innovation in service differentiation.

3.3.4 Colombia

Claro differentiates through wide coverage and superior infrastructure. Its pricing strategies are complemented by significant investment in technology and advertising. Movistar emphasises customer service and digital platforms (e.g., self-management apps). Tigo, despite being a follower, introduced the first *quadruple-play* bundle and has focused on integrated service packages to improve customer retention. However, Claro's economies of scale and investment power maintain its market leadership.

3.3.5 Mexico

Telcel (América Móvil) dominates with brand recognition, coverage, and extensive retail presence. Its strategic behavior includes handset financing, exclusive distribution agreements, and zero-rated content. AT&T, in contrast, focuses on the premium and business segments, offering plans with U.S.-Mexico cross-border coverage. Smaller competitors and MVNOs find it difficult to scale, partly due to Telcel's infrastructure control and promotional flexibility.

3.3.6 Peru

Movistar leads with bundled plans and extensive infrastructure. Claro competes on network quality and promotional packages, especially in rural areas. Entel, the main challenger, focuses on youth-oriented marketing, data-based plans, and customer service. Despite this, strategic room is limited by spectrum distribution and economies of scale, which favor incumbents.

3.4 Regulatory Analysis

Understanding market concentration in Latin America requires examining not only regulatory frameworks but also the historical and structural roles of leading telecommunications firms in each country. The dominance of operators such as América Móvil and Telefónica has shaped competitive dynamics, often outpacing regulatory responses and reinforcing oligopolistic structures.

3.4.1 Argentina

In Argentina, the mobile market is led by Claro (América Móvil), Movistar (Telefónica), and Personal (Telecom Argentina). The regulatory body ENACOM has attempted to promote competition through infrastructure sharing and spectrum redistribution. However, América Móvil and Telefónica have benefited from early market entry and sustained investment, enabling them to capture broad user bases and extensive infrastructure coverage. Telecom Argentina, through Personal, merged with Cablevisión in 2018, further consolidating the market.

3.4.2 Brazil

Vivo (Telefónica) holds the largest market share in Brazil, followed by Claro and TIM. The 2022 acquisition of Oi Móvel—previously the fourth major operator—by this trio marked a critical shift in market structure. Brazil's regulator ANATEL approved the deal with specific conditions, but the long-term impact has been increased concentration. Telefónica's presence via Vivo has been strategically reinforced through bundling and control of fixed and mobile infrastructure, allowing vertical integration and reducing space for competition.

3.4.3 Chile

Chile's market is considered one of the most competitive in the region. The presence of Entel, a strong domestic firm, along with Movistar, Claro, and more recently WOM, has diversified the market structure. Chile's regulator SUBTEL has enforced pro-competition policies, including effective support for MVNOs, spectrum caps, and number portability. WOM's disruptive entry strategy—focused on aggressive pricing and investment in 4G and 5G infrastructure—has reduced the market share of legacy players, showing that regulatory design can facilitate entry and competition.

3.4.4 Colombia

Claro (América Móvil) dominates Colombia's mobile market, often holding over 50% market share. It has benefited from early infrastructure development and favorable positioning during the liberalisation process in the 1990s. Movistar (Telefónica) and Tigo (Millicom and EPM joint venture) follow, but with significant gaps in market power. The regulatory authority CRC has made efforts to limit dominance through asymmetric regulation

and wholesale access requirements. However, Claro's vertical integration and investment capacity continue to be decisive in shaping competition. Tigo's strategy after merging with UNE has focused on quadruple play offerings, but it has not significantly disrupted Claro's leadership.

3.4.5 Mexico

Mexico is home to América Móvil's flagship brand, Telcel, which holds a dominant position with over 60% of the market. Despite reforms led by IFT (Instituto Federal de Telecomunicaciones) aimed at reducing Telcel's market power—including declaring it a "preponderant economic agent"—its infrastructure ownership and broad subscriber base remain structural advantages. Although AT&T entered the market through acquisitions of Nextel and Iusacell in 2015, it has struggled to challenge Telcel's dominance. The presence of MVNOs has increased, but they remain marginal in terms of total market share.

3.4.6 Peru

Peru's market is led by Movistar, followed by Claro and Entel. The regulator OSIPTEL has implemented measures to reduce switching costs and improve transparency in tariffs. However, Movistar and Claro continue to dominate through long-standing infrastructure investments and aggressive marketing strategies. Entel, despite entering the market via the acquisition of Nextel in 2013, faces limitations in spectrum allocation and scale. This has hindered its ability to compete on equal terms.

4. Results and Analysis

4.1 Regional Overview: Market Concentration and Dominant Firms

The analysis reveals a consistent pattern of high market concentration across the six countries studied. In all cases, the Herfindahl-Hirschman Index (HHI) exceeds 2,500—indicating highly concentrated markets under international standards. The most dominant firms across the region are América Móvil (operating under the brands *Claro* and *Telcel*) and Telefónica (operating as *Movistar*), which together hold the majority of market share in each country.

Across the six countries analysed:

- C2 values (combined market share of the top two operators) consistently exceed 70%
- C3 values (combined market share of the top three operators) approach or exceed 90%
- The presence of MVNOs is limited in all countries except Chile and Mexico, where regulations are more favorable to new entrants

These findings suggest that despite formal liberalisation and privatisation processes, effective competition remains weak in practice due to structural dominance.

4.2 Country-Level Results

4.2.1 Argentina

The mobile market in Argentina is dominated by Claro, Movistar, and Personal. HHI values in recent years have remained above 2,800, with Claro leading the market. Regulatory efforts have promoted MVNOs, but with limited market penetration.

4.2.2 Brazil

Brazil's market is one of the largest in the region. After the acquisition of Oi Mobile by the top three players in 2022, the HHI increased significantly to values close to 3,000, reflecting growing concentration. The main operators—Vivo (Telefónica), Claro, and TIM—control nearly the entire market.

4.2.3 Chile

Chile stands out for its relatively better regulatory framework and more dynamic competition. The presence of Entel, WOM, and Movistar makes the market less concentrated (HHI around 2,400–2,600) compared to the regional average. Chile also has the highest number of active MVNOs.

4.2.4 Colombia

Colombia's market is structured as an oligopoly, with Claro holding more than 50% of market share, followed by Movistar and Tigo. The HHI remains above 3,000, and despite regulatory measures, market dynamics favor incumbent firms. Bundled service offerings and network control reinforce dominant positions.

4.2.5 Mexico

In Mexico, Telcel (América Móvil) controls over 60% of the mobile market, resulting in an HHI of approximately 3,800. Despite recent regulatory reforms to curb dominance and promote MVNOs (e.g., AT&T, Virgin Mobile), Telcel's market power remains largely unchallenged.

4.2.6 Peru

Peru's market is also highly concentrated, with Movistar and Claro controlling nearly 80% of the market. The HHI is consistently above 2,800. Entry by Entel has introduced some competitive pressure, but it has not been sufficient to significantly alter market structure.

4.3 Strategic Behavior and Regulation

Across all countries, incumbent firms employ similar strategic behaviors:

- Service bundling: Combining mobile with internet, TV, and fixed telephony
- Heavy investment in network infrastructure and spectrum to limit entry
- Aggressive marketing and pricing strategies to lock in customers
- Brand loyalty and switching costs, which reduce consumer mobility

Despite the presence of national regulators, regulatory capacity varies widely. In countries such as Chile, oversight and enforcement are relatively strong. In contrast, Colombia, Mexico, and Brazil show institutional limitations in curbing dominance and ensuring fair competition.

5. Discussion and Conclusions

This study has examined the mobile telecommunications market in six Latin American countries through the lens of industrial organisation theory. The empirical findings confirm the presence of high market concentration across the region, with América Móvil and Telefónica acting as dominant players. In several markets, the Herfindahl-Hirschman Index (HHI) exceeds 3,000, indicating a structural tendency toward oligopoly or even near-duopoly conditions.

5.1 Strategic Behavior and Market Power

The analysis highlights that dominant firms use a consistent set of strategies to entrench their market position:

- Bundling services to increase switching costs and reduce churn
- Aggressive infrastructure investment, which creates entry barriers
- Brand loyalty and wide distribution networks, especially in rural areas
- Vertical integration between mobile and fixed services

These strategies are not inherently anti-competitive, but in the context of limited rivalry and uneven regulatory enforcement, they reinforce concentration and reduce the effectiveness of formal liberalisation.

The case of Claro in Colombia and Mexico, for example, illustrates how a combination of early entry, infrastructure control, and bundled offerings can lead to near-monopoly conditions, even in supposedly competitive environments. Similarly, Telefónica's presence across multiple markets supports its cross-border learning, efficiency, and capacity to adapt strategies according to national regulation, often outpacing local competitors.

5.2 Regulatory Challenges

Although all countries examined have regulatory frameworks intended to foster competition, these frameworks suffer from several limitations:

- Regulatory capture and political constraints on enforcement
- Unequal access to spectrum and infrastructure for new entrants
- Limited financial and technical capacity of regulators, especially outside capital cities
- Slow adaptation to digital market dynamics, such as OTT services and data-centric competition

Only in Chile does the regulatory regime show sustained success in promoting competition, partially due to stronger institutional autonomy, effective spectrum policy, and robust support for MVNOs. In contrast, Mexico and Colombia show significant gaps between regulatory intent and market outcomes.

5.3 Policy Recommendations

To enhance competition and improve consumer welfare, the following policy actions are recommended:

1. Strengthen regulatory independence and enforcement capacity, especially in spectrum management and infrastructure sharing.
2. Facilitate the entry and growth of MVNOs through simplified licensing, mandatory wholesale access, and transparent pricing models.
3. Expand number portability and switching facilitation policies to reduce consumer inertia.
4. Implement stricter ex-ante rules for dominant firms, particularly in highly concentrated markets.
5. Promote regional coordination, especially for multinational operators, to avoid regulatory arbitrage and ensure consistent oversight across countries.

5.4 Final Remarks

The mobile telecommunications market in Latin America reflects broader structural challenges in balancing liberalisation, competition, and regulation. While the sector has achieved impressive growth and technological advancement, market power remains concentrated in a few firms whose strategic behavior shapes the competitive landscape. As shown in Table 1, the Herfindahl-Hirschman Index (HHI) remains high across all six countries, and regulatory responses vary significantly, highlighting persistent asymmetries. Future research should explore the impact of digital convergence (e.g., mobile payments, streaming, and IoT services) on market dynamics, as well as the role of regional regulatory harmonisation.

Ultimately, fostering a more inclusive, dynamic, and fair telecommunications ecosystem in Latin America requires not only institutional reforms but also political will to prioritise consumer rights and long-term innovation over short-term market stability. Without stronger regulatory oversight and coordinated policy reforms, market concentration in Latin American telecommunications will likely persist. This poses risks not only for fair competition but also for long-term digital inclusion, innovation, and sustainable economic development in the region.

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Ethics Declaration

This research did not involve human participants, animals, sensitive personal, or experimental interventions, and therefore did not require formal ethical clearance. All data used in this study was obtained from publicly available sources or official institutional databases.

AI Declaration

Artificial Intelligence (AI) was used in the preparation of this paper exclusively for language editing and style improvement in English. As the author's primary language is Spanish. The content, data analysis, and academic

arguments were developed entirely by the author. The AI tool assisted in refining the clarity, grammar, and coherence of the written English to meet the requirements of an international audience.

Table 1: Market Concentration and Regulation Overview by Country

Country	Main Operators	HHI (2023)	Regulatory Environment
Argentina	Claro (América Móvil), Movistar (Telefónica), Personal	~2,800	Moderate regulation; attempts to foster MVNOs and competition through infrastructure sharing. Dominance of three large operators.
Brazil	Vivo (Telefónica), Claro, TIM	~3,000	ANATEL enforces spectrum caps and merger conditions. Oi Mobile's exit in 2022 increased market concentration.
Chile	Entel, Movistar, WOM, Claro	~2,400–2,600	Strong regulation by SUBTEL; most successful MVNO market in the region; active spectrum management and competitive incentives.
Colombia	Claro (América Móvil), Movistar, Tigo	~3,200	CRC uses asymmetric regulation to limit Claro's dominance. Limited effectiveness due to Claro's infrastructure control and bundling practices.
Mexico	Telcel (América Móvil), AT&T, Movistar	~3,800	Telcel designated as a "preponderant agent" by IFT. MVNO entry encouraged but structural dominance remains. Regulation enforcement has been uneven.
Peru	Movistar, Claro, Entel	~2,800–3,000	OSIPTEL promotes competition and portability. Incumbents still dominate due to early investment and scale advantages.

Source: Author's elaboration based on ITU, ECLAC and national regulatory agencies (2023).

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Harnessing Generative AI as a Knowledge Companion in the Venture Creation Process: An Exploratory Study

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Abstract: Artificial intelligence is creating an astute impact on new venture creation. In recent years, large language models (LLMs), such as Generative AI (GenAI), have played a pivotal role in adopting artificial intelligence. GenAI is a potential instrument for providing knowledge, assistance and suggesting ideas throughout various entrepreneurial phases. Entrepreneurs can leverage GenAI to identify and exploit novel business opportunities in the dynamic market. GenAI may serve as a knowledge base in the entrepreneurial learning of nascent entrepreneurs. However, the adoption of GenAI in venture creation from an entrepreneur's perspective has received limited attention. This research delves into the capabilities of GenAI as a knowledge companion for nascent entrepreneurs on their entrepreneurial path. This study uses a qualitative approach comprising semi-structured interviews with nascent entrepreneurs to explore the application of GenAI, precisely ChatGPT, in the early stages of venture creation. The thematic analysis uncovered patterns in how participants leverage Generative AI throughout their entrepreneurial journeys. Findings support the capabilities of GenAI to be a knowledge repository in venture creation. The key themes that emerge from the analysis are idea and opportunity recognition, market research, operation, and business incorporation. The study highlights ChatGPT's ability to make the venture creation process more cost-effective. ChatGPT can be an accessible and multifunctional tool for entrepreneurs to create a venture without prior knowledge or experience. The themes are associated with the utility of ChatGPT in the venture creation process by nascent entrepreneurs. The study contributes to the growing literature on AI's role in the venture creation process. This extends the scope of human-AI collaboration to exploit entrepreneurial opportunities and foster innovative entrepreneurial pathways.

Keywords: Artificial Intelligence, Entrepreneurs, Venture Creation, Generative AI, Entrepreneurial Process

1. Introduction

Artificial intelligence (AI) is revolutionizing the entrepreneurial landscape with the help of various AI-based technologies that enhance the organization's efficiency and effectiveness (Blank, 2023; Chalmers et al., 2020). The theme of "AI-driven economy" broadens to incorporate "AI Augmentation and Automation". AI is being integrated into idea generation, marketing, and scaling. Furthermore, AI can also be fostered as a knowledge repository and companion (Chalmers et al., 2020; Chatterjee & Dethlefs, 2023; Gupta, 2024). This concept promotes the notion of integrating GenAI into analyzing data and ascertaining patterns to discover new business opportunities, and this helps entrepreneurs make informed decisions and mitigate some uncertainty in launching a new venture. Literature suggests that GenAI is a beneficial tool that can improve various business processes. GenAI is a conversational technology in the innovation cycle of AI that is swiftly adopted in all types of businesses, from MSMEs, Startups, and to Giants of the market (Haenlein & Kaplan, 2019; Sharma et al., 2024; Vecchiarini & Somià, 2023). ChatGPT, a form of GenAI, is prominently diffusing into diverse industries. Recent studies have recommended that ChatGPT can contribute valuable insights for business model development (Chatterjee & Dethlefs, 2023; Rahaman, 2023; Vecchiarini & Somià, 2023). "AI and ChatGPT will revolutionize customer discovery" (Blank, 2023). GenAI can be associated with tuning key blocks of the business model to market research and customer engagement. ChatGPT will systematize the process of developing minimum viable products (MVPs) and crafting business plans by assisting entrepreneurs (Blank, 2023; Vecchiarini & Somià, 2023).

Venture creation is the outcome of the interaction between the entrepreneur and the environment. The entrepreneur plays the central role in entrepreneurship. An entrepreneur requires cognitive skills and heuristics to pass this crucial journey of entrepreneurship to create a venture (Shook et al, 2003). ChatGPT may be an excellent beginning for nascent entrepreneurs to make this process a little easier, as it can serve as a cost-effective knowledge repository (Gupta, 2024). This research delves into the inclination of ChatGPT as a knowledge companion for nascent entrepreneurs in their venture creation process. The study aims to

understand how nascent entrepreneurs can leverage ChatGPT to acquire meaningful insights and information during the early phases of venture creation. By scrutinizing the application of ChatGPT in this context, the study extends toward the potential implications of GenAI in business planning and operational processes within the sphere of entrepreneurial pursuits. The objectives of this research are:

- RO1: To examine whether GenAI can assist nascent entrepreneurs in starting the process of venture creation.
- RO2: To unfold the use cases of GenAI in the early stage of the entrepreneurial path.

2. Literature Review

New venture creation is defined as "To organize is to assemble ongoing interdependent actions into sensible sequences that generate sensible outcomes" in new organizations (Weick, 1979; Gartner, 1985). The venture creation process is a multi-dimensional phenomenon that involves the entrepreneur - the person or team who started the organization, the environment – the parameters that influence the organization, the organization – the type of firm started, and the process – the activities endorsed to start the venture (Gartner, 1985; Kuckertz *et al.*, 2017). An entrepreneur identifies the opportunity and performs different activities to successfully exploit it (Edelman and Yli-Renko, 2010; Short *et al.*, 2010; Galanakis and Giourka, 2017). Bhave (1994) Conducted qualitative research with 27 businesses and developed a model for the venture creation process. The model highlights internally and externally stimulated opportunity recognition, commitment to physical creation, set-up of production technology, organization creation, product creation, linking with markets, and customer feedback. Over the years, advancements in AI technology may accelerate this process and assist entrepreneurs (Chalmers *et al*., 2020; Weber *et al.*, 2022; Cooper, 2025).

AI originated around the 1940s, particularly in 1942, when an American science fiction writer, Isaac Asimov, published his short story "Runaround." However, AI became a reality in 1956 during the Dartmouth Summer Research Project on Artificial Intelligence (DSRPAI), organized by Marvin Minsky and John McCarthy at Dartmouth College (Allen,2020; Haenlein & Kaplan, 2019). Over the past few decades, AI has evolved as multidisciplinary and interdisciplinary, involving all these domains and numerous other domains (Shao et al., 2022). The innovations of AI have created ease of use for everyone. GenAI is one AI technology that serves this purpose, and it produces text, audio, and video according to user requirements. ChatGPT is one example of GenAI that was trained with vast data to generate textual responses (Gupta & Yang, 2024). ChatGPT is not only limited to mimicking human conversation but also engages in complex tasks that involve creativity and innovation. ChatGPT has the potential to generate novel insights based on the patterns found in the trained data. ChatGPT can help entrepreneurs in their venture creation process and help in their entrepreneurial learning (Ratten, 2023; Short & Short, 2023). The expansion and traction received by ChatGPT have given a way of seeing it as a friend and learning companion to entrepreneurs (Rahaman, 2023; Chatterjee & Dethlefs, 2023). Vecchiarini & Somià (2023) conducted an experimental study with entrepreneurial students, The authors suggested that ChatGPT is capable of helping entrepreneurs. ChatGPT is able to give valuable insights into marketing, competitor analysis, and legal aspects. Entrepreneurs may use ChatGPT to automate customer discovery and validation processes (Blank, 2023). ChatGPT can be trained according to the requisites, and its learning ability will give entrepreneurs better insights into decision-making (Li et al., 2022; Colson, 2019). The entrepreneurial process is a complicated journey involving an individual's personal and professional stakes. ChatGPT may become a knowledge companion for nascent entrepreneurs looking for guidance and direction in venture creation (Gupta, 2024). There is limited research on the actual utility of ChatGPT in the venture creation process from the entrepreneur's perspective. Entrepreneurs are naturally innovative, which gives them a greater scope to use ChatGPT in more ways to optimize and be efficient in venture creation.

3. Methodology

A qualitative study has been adopted employing purposive sampling, focusing on student founders currently operating their startups and recent graduates who have embarked on their entrepreneurial endeavors. The growing interest in entrepreneurship in India has created an optimistic opinion among students. The rapidly increasing investments and government initiatives have encouraged them to choose the path of entrepreneurship. The founder's compatibility with technology often leads to experimenting with emerging technologies in their entrepreneurial journeys. The founder's actions towards creating a venture, their compatibility with technology, and their limited entrepreneurial experience are suitable criteria for the study to explore how ChatGPT can help nascent entrepreneurs. The semi-structured interviews were conducted with

eight founders, online and offline, to accommodate participant availability from September 2024 to March 2025. Interviews lasted from 40 minutes to 70 minutes. Additionally, we had informal discussions with two entrepreneurs for six months to better understand ChatGPT's utility. The interviews allowed us to collect in-depth data, but recurring themes eventually led to saturation. The entrepreneurs represented diverse backgrounds with startups spanning various sectors such as Healthcare, AR/VR, Edtech, Beauty and personal care, E-commerce, and Business Services. As the table below shows, all startup founders are in the *ideation or validation stage.*

Table 1: Respondent Details

Company Details			**Founder Details**	
Company Name	*Age of the Company (by Dec 2024)*	*Industry/Sector*	*Education*	*Year of Graduation*
Vifr	3 years	AR/VR	Bachelor of Technology	2022
Newbie learning	2 years 6 months	Edtech	Bachelor of Technology	2025
build3	1 year 5 months	Education services	Bachelor of Technology	2024
Picapool	2 years 5 months	E Commerce	Bachelor of Technology	2025
Ira Healthcare	1 year 5 months	Healthcare	Bachelor of Business Administration	2023
Skinkare	2 years	Beauty and personal care	Bachelor of Legislative Law	2024
Sex and Bites	1 year 7 months	Food and Beverage	Bachelor of Business Administration	2024
Artisan Works	3 years	Consumer goods	Master of Business Administration	2022

ChatGPT was selected as the focal point for the proposed study among all available tools in the market due to its widespread usage and rapid user adoption. Given its widespread popularity and extensive user base, its accessibility contributed significantly to its suitability as a research tool (Vecchiarini & Somià, 2023). The freely available versions, ChatGPT-3.5 and ChatGPT-4o, meant anyone could jump in and experience its potential. To get a real-world picture, we dug deep with startup founders. Firstly, they delved into the daily grind, exploring how founders seamlessly integrated ChatGPT into their operations. The goal is to understand how this AI tool streamlined everyday tasks and potentially revolutionized business processes. Secondly, the interviews did not shy away from the frontiers of innovation. Open-ended questions encouraged founders to share how they leveraged ChatGPT's potential for venture creation. This way, we can shed light on the creative and ingenious applications driving their startups forward, showcasing the true potential of AI in the ever-evolving world of entrepreneurship.

Thematic analysis was applied to scrutinize the qualitative data to uncover inherent patterns and themes concerning participants' perspectives (Braun & Clarke, 2006). The interviews underwent transcription, followed by the utilization of NVivo software for streamlined coding and thematic extraction from the transcribed interviews. Initial themes were developed through manual coding and software-assisted methods, leading to the generation of first-order themes. These primary themes were further refined to create second-order themes, which were then integrated into sub-themes to elucidate the research findings. Ultimately, aggregate themes were derived after a comprehensive review and synthesis of the first and second-order themes. Themes generated through NVivo are discussed with participants to validate the interviews. This analytical endeavor's central objective was to elucidate ChatGPT's primary utilization scenarios within the context of new venture creation processes to provide indispensable support to aspiring entrepreneurs along their entrepreneurial trajectories.

4. Results

The findings offer valuable insights into the ways entrepreneurs from diverse backgrounds make use of ChatGPT, especially in the nascent stage, which reveals four key themes with sub-themes highlighting how ChatGPT supports various aspects of their ventures:

4.1 Idea and Opportunity Recognition

4.1.1 Idea Sorting

Entrepreneurs frequently develop several ideas, but not all are desirable (Blank, 2023). They utilize ChatGPT to analyze the advantages and disadvantages of potential ideas, which helps them identify the most promising ones to pursue. This saves them time and resources on weak concepts, which apply to high-level business concepts and functional operational ideas.

"We take ideas from ChatGPT. So, whenever we run out of ideas, we want to improve something, and we don't know how to implement that. In that case, we use Chat GPT where it gives us steps on how to do it and the procedure on how to do it" (Founder of Newbie learning)

4.1.2 Feasibility Analysis

Feasibility is necessary to pursue an idea and create a venture (Corbett,2005). Nascent entrepreneurs with limited experience have certain restrictions when assessing the idea's feasibility. ChatGPT can help them by giving multi-dimensional perspectives on opportunities and directions to exploit them.

"*We start with a simple problem how to like about the topic we want we want those ideas on and after we get one idea, we asked it to elaborate it and we often check its popularity and we often prompt more again and again for several times for at least six to ten times for one idea."* (Founder of build3)

4.2 Market Research

4.2.1 Market Overview

Entrepreneurs need to understand market dynamics in-depth to tap into the right market and know different novel use cases (Vecchiarini & Somià, 2023). ChatGPT assists nascent entrepreneurs in gaining a holistic view of the market with opportunities and challenges. It can lead them through new product development by providing valuable insights from the vast information available.

"I use ChatGPT mostly to understand the market for myself, so it gives like the latest information, and I use it to understand the market for myself, so I use it to understand the market it's it gives me more than I asked for sometimes" (Founder of build3)

"I wanted to also research a little bit more about the current products, like skincare products that are available on the market, trending in the market." (Founder of Skinkare)

4.2.2 Competitor Analysis

It is crucial to know the products available in the market to develop new products or services (Vecchiarini & Somià, 2023). Entrepreneurs must critically evaluate the competitors to find product and service differentiation opportunities. ChatGPT is a good tool for identifying all direct and indirect competitors in the market, leaving them with an edge.

"One of the main purposes … was to know about the competitors. … And then apart from that, I wanted to also research a little bit more about the current products … trending in the market." (Founder of Picapool)

4.3 Product management

4.3.1 Coding Assistance

Coding has become a necessity for entrepreneurs to build technology-based products or services, despite the nature of the organization. Entrepreneurs who need more coding proficiency need assistance to become

technically oriented. ChatGPT enables nascent entrepreneurs to pursue tech-oriented ideas by providing coding support in error identification, debugging, and writing new code.

"We also use it for our coding purposes, like whenever we have a bug or an issue, we just use it for debugging or to understand what the problem is about." (Founder of Ira Healthcare)

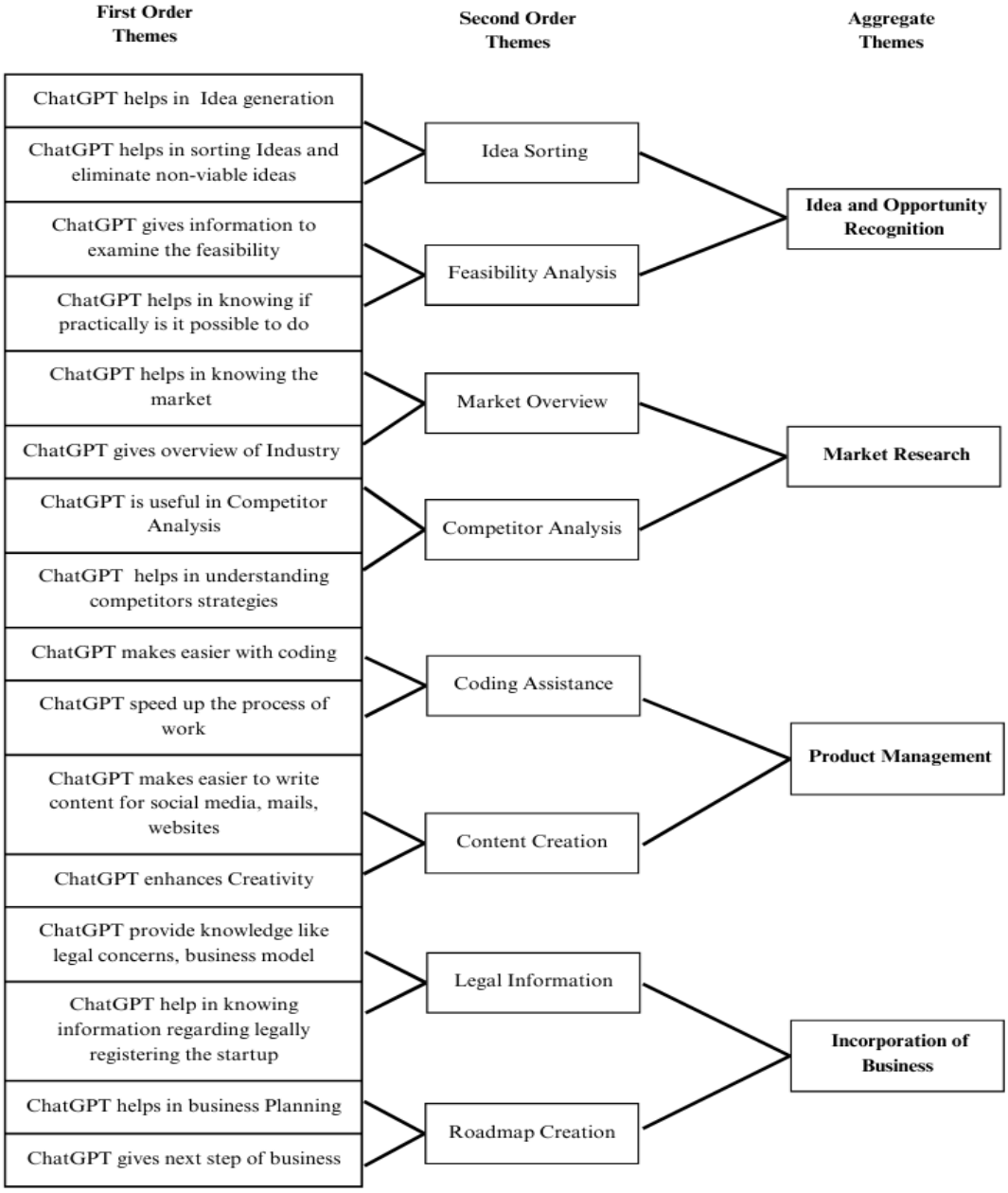


Figure 1: First-order themes, Second-order themes, and Aggregate themes

4.3.2 Content Creation

Being an effective communicator is a priority for entrepreneurs. They must provide engaging and high-quality content for social media, blogs, and investor pitches. ChatGPT empowers entrepreneurs to create compelling content for their target customers and prospective partners. It is a cost-effective option that helps nascent entrepreneurs become more confident in their presentations.

"I use ChatGPT to write emails. That helped me a lot. The second thing, uh, why emails? Because as the co-founder or at the business face of the startup, I need to communicate with many people, multiple people. And sometimes I want some, you know, some particular email in some particular genre that should be a bit appealing or that should be, you know, sophisticated" (Founder of Picapool)

4.4 Incorporation of Business

4.4.1 Legal Information

ChatGPT equips entrepreneurs with the foundations of legal requirements of business incorporation. It provides the government norms regarding incorporating business and navigating entrepreneurs through the legal aspects of entrepreneurship.

"Recently, we did our incorporation… I put all those MOA, AOA, and all into ChatGPT and asked, 'Can you explain in lay terms?' So GPT helped me to understand the legal terms in that way." (Founder of Sex and Bites)

4.4.2 Roadmap Creation

It is human nature to look for guidance in any aspect. Nascent entrepreneurs also seek guidance to carve their entrepreneurial pathways. ChatGPT can be their companion and give periodic insights throughout their early phase journey of entrepreneurship. ChatGPT assists entrepreneurs in developing a comprehensive roadmap in the initial phase of new venture creation.

"We have used ChatGPT to give us a step-by-step plan to learn something to be able to accomplish the goal." (Founder of Picapool)

"Be it steps or be it a plan that is formed on a month-on-month basis towards a certain goal … we can have it come back with the specific results that we want." (Founder of Vifr)

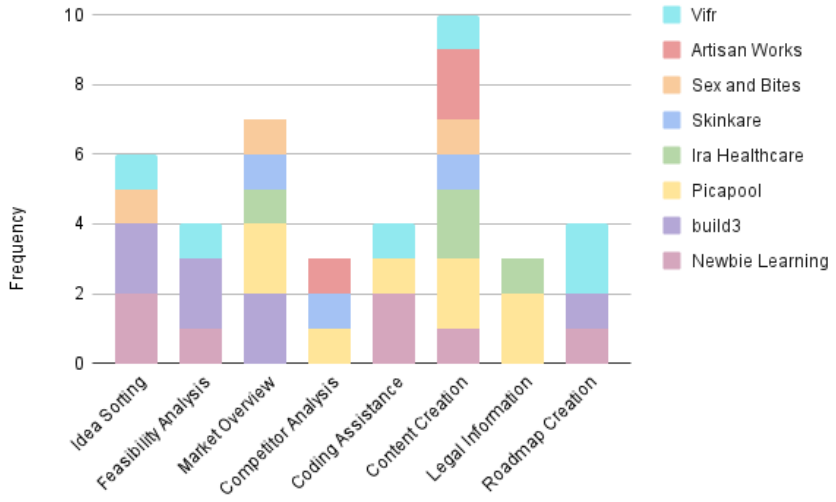


Figure 2: Frequency of second-order themes across startups

Across eight startups, the analysis highlights different frequencies of each theme in Fig. 2. Content creation emerges as the most dominant use of GenAI and followed by market overview. Competitor analysis and legal information are less cited, but that shows the creative use of GenAI by founders. All the themes together show the practical utility of GenAI in the venture creation process.

5. Discussion

The findings support the potential of GenAI to provide more interactive and personalized experiences of venture creation (Calandra et al., 2024). Furthermore, ChatGPT functionality suggests it has the potential to be a knowledge repository for business enthusiasts (Hakiki et al., 2023; Gupta, 2024). Sorting ideas and conducting feasibility analyses shows how entrepreneurs can utilize ChatGPT to examine many concepts and prioritize viable ones. Similarly, ChatGPT's access to vast data provides critical perspectives on opportunities that resonate with the flexibility of AI to customize the learning experience (Chalmers et al., 2020).

Anticipating the future of AI and ChatGPT can lead to ultimately automating the customer discovery and validation processes (Blank, 2023; Vecchiarini & Somià, 2023). ChatGPT may be a valuable tool by looking into its potential to generate diverse content for entrepreneurs (Short & Short, 2023). The research findings validate these notions. Entrepreneurs employ ChatGPT for various functions, including market research, customer

needs, feedback, and product development. Competitor analysis by ChatGPT aids in recognizing both direct and indirect competitors, facilitating product and service differentiation strategies (Vecchiarini & Somià, 2023). Providing coding support for entrepreneurs lacking coding expertise enhances operational efficiency and streamlines the developmental processes (Gupta, 2024). Additionally, content creation capabilities enable the generation of compelling content for social media, blogs, and investor presentations, potentially diminishing dependence on professional services (Short & Short, 2023). These findings showcase how GenAI expands the entrepreneurial toolkit, empowering entrepreneurs with functionalities beyond traditional business acumen.

It is important to acknowledge that GenAI should not replace human involvement. Our research suggests that the most effective approach may be collaboration, where AI and humans leverage each other's strengths to make better decisions (Colson, 2019). AI excels at detecting external changes that signal potential opportunities (Shepherd & Majchrzak, 2022). A key limitation identified with ChatGPT, an educational resource, is its long-term efficacy. Another limitation identified is the chance for AI-generated inaccurate information, requiring users to exercise caution and conduct verification (Calandra et al., 2024). The findings may also have these limitations. The legal information provided by ChatGPT equips entrepreneurs with foundational knowledge, but navigating the legal complexities of business incorporation may still require professional guidance. Similarly, roadmap creation with ChatGPT offers valuable guidance during the early stages, but entrepreneurs should remain adaptable and refine their strategies as their ventures evolve.

6. Conclusion

The research highlights the transformative potential of AI, precisely GenAI, as a knowledge companion in entrepreneurial process. GenAI can be leveraged from intent, opportunity discovery, exploitation, and venture creation in the entrepreneurial process. AI technologies and tools can personalize learning experiences, support idea validation, and streamline entrepreneurial tasks. The analysis provides valuable insights from diverse entrepreneurs into how entrepreneurs can leverage ChatGPT through their entrepreneurial journey. This research adds empirical evidence to the literature on enabling AI towards organizational orchestration from an entrepreneur's perspective. However, it is crucial to acknowledge limitations and accentuate human-AI partnerships. Future research should explore the long-term influence of AI on business processes and develop frameworks to leverage AI to the maximum while mitigating its limitations. Combining human knowledge and AI capabilities will empower entrepreneurs to navigate the ever-evolving landscape.

Ethics Declaration

We declare that the research conducted in this paper does not require ethical approval.

AI Declaration

We declare that no artificial intelligence tools were used to develop this paper.

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Unraveling the Role of Culture in Social Entrepreneurial Ecosystems

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Abstract: This study explores the role of culture in shaping social entrepreneurship ecosystems with a lens of context dependent framework on culture. While ecosystems have been studied in terms of actors, networks, and resources, the cultural layer remains understudied. Responding to the lack of in-depth, culturally informed analysis beyond broad syntheses in literature on the topic, this study sheds light on national social-enterprise ecosystems through Abramson's context-dependent model to show how locally embedded values, meanings, resources and motivations shape, and are in turn shaped by entrepreneurial ecosystem dynamics, thus extending existing theory. A qualitative content analysis is used to analyze four EU social enterprise ecosystem country reports in terms of how they describe cultural meanings, resources and motivations in the country's social enterprise ecosystem. The findings shed light on which cultural elements are emphasized within social entrepreneurship ecosystems across different country contexts. Through cross-analysis, four thematic categories are identified, describing cultural elements emphasized in the country's social enterprise ecosystems, welfare and institutional models, history of cooperatives, associations, perceptions of entrepreneurship, the role of institutions and the overlapping category of values and norms. This study argues culture in social entrepreneurial ecosystems can be studied viewing culture as an overarching and inseparable dimension, from a more heuristic point of view. The key themes that emerge from the study are the role of welfare systems, perceptions of entrepreneurship, institutions, values. These themes function as symbolic carriers of cultural meanings in social entrepreneurial ecosystems.

Keywords: Social Enterprise Ecosystems, Social Enterprise, Entrepreneurial Ecosystems, Culture

1. Introduction

Social enterprises by nature engage in market methods while simultaneously solving social problems (Kerlin 2013). It is known that institutional contexts influence evolving social enterprise ecosystems (Kerlin 2013), and social entrepreneurship ecosystems in general are influenced by institutional and cultural factors. While formal institutions have received attention in literature, the role of culture in the ecosystems remains underexplored, despite the rising interest in understanding cultural influences in social entrepreneurial ecosystems (Roundy & Bonnal 2017; Diaz Gonzalez & Dentchev 2021). This study offers perspective in this gap by investigating how cultural elements are presented in social enterprise ecosystems across different country contexts.

Likewise, there is a gradual shift in policymakers' attention towards social entrepreneurial ecosystems. Since 2021, EU policy has shifted from supporting individual social enterprises to building full social economy ecosystems, recognizing the need for legal, financial, and structural support across all levels. This approach aims to align diverse local social economy actors with broader EU goals like the single market, green transition, and social cohesion, while respecting diversity of actors in the field (Carini et al. 2024). Culture affects social entrepreneurship practices and policies.

Cultural elements are shown in many ways in entrepreneurial ecosystem theoretical perspectives. Culture has been approached in numerous ways, as fixed attributes such as collectivism-individualism (Kerlin 2013; Coskun et al. 2019), as a conducive culture shaping opportunity perception, failure tolerance, entrepreneurial identity, (Isenberg 2010) or entrepreneurial culture (Stam & van De Ven 2021). Roundy (2017) highlights the importance of culture in the broader context of social ventures, emphasizing that to fully understand their success or failure, researchers and practitioners must consider the cultural forces that shape them, from perceptions of social problems to the organization and legitimization of social entrepreneurship ecosystems, though this issue is not explored in greater detail.

Despite these calls, culture's dynamic role in entrepreneurial ecosystems is overlooked. A more comprehensive perspective to culture is required. This study applies the lens of context dependent theory on culture by Abramsson (2012), defining culture as meanings, resources and motivations. This lens offers a more holistic and dynamic view to culture in entrepreneurial ecosystems compared to the prior theoretical perspectives on culture in entrepreneurial ecosystems. This perspective moves beyond viewing culture instrumentally, offering a more integrated understanding of its dynamic and embedded role in shaping ecosystem practices. A qualitative

content analysis is used to analyze four EU social enterprise ecosystem country reports in terms of how they describe cultural meanings, resources and motivations in the country's social enterprise ecosystem.

The findings shed light on what cultural elements are emphasized in four EU social enterprise country ecosystem reports (European Commission 2018, European Commission 2019a, 2019b, 2019c). By cross analyzing the data, four thematic categories are identified, explaining major cultural elements: welfare models, cooperative history, associations, entrepreneurship perceptions, institutional roles, and values and norms. This study broadens the understanding of culture in social entrepreneurial ecosystems, offering a new analytical lens and advocating for context-sensitive support mechanisms. Social enterprises and their ecosystems are culturally mediated, with cultural elements acting as scripts that shape their actions, relationships, and evolution.

2. Theoretical Background

The use of various ecosystem concepts has seen a rise in management and organizations studies over the last decades. The entrepreneurial ecosystem as a concept underlines system nature and interconnectedness of actors and context for entrepreneurship in particular regions (Phillips & Ritala 2019; Stam & van de Ven 2021; Stephens et al. 2021) or organized around geographically dispersed networks (Isenberg 2010).

Social enterprises are particularly influenced by their regional context (Kerlin 2013). Practitioners and scholars have suggested that social enterprise ecosystems are different from traditional enterprise ecosystems (Bozhikin 2023; European Commission 2021). Bozhikin (2023) highlights that these issues have been examined both from a broad perspective and through the lenses of specific industries or geographical regions. Social enterprise ecosystems develop as response to social issues that actors aim to address (Bozhikin 2023). Warnecke & Balzac-Arroyo (2023) comment that communities have a central role in social enterprise ecosystems. The literature emphasizes a need to understand better how various factors influence the success of social enterprises to develop strategies to strengthen the social entrepreneurship ecosystems (Diaz Gonzalex & Dentchev 2021; Lorenz et al. 2024).

Cultural elements are shown in many ways in entrepreneurial ecosystem theoretical perspectives. Kerlin (2013) chooses to focus on cultural traits that are likely to influence social enterprise, in-group collectivism vs. individualism and uncertainty avoidance. These are seen to link with innovation and resource mobilization. Coskun et al. (2019) build on the work on Kerlin and add two variables to culture in their social enterprise framework but find in their analysis that collectivism vs. individualism remains the only significant one. These dimensions are recognized as significant but in this study, they are not addressed in depth here, as they concentrate on culture as more fixed attributes.

In Isenberg's entrepreneurship ecosystem framework culture is positioned as one key dimension alongside policy, finance, support systems, human capital, and markets. Isenberg (2010) sees a conducive culture as essential to fostering entrepreneurship, suggesting that culture influences how opportunities are perceived, how failure is tolerated, and how entrepreneurial identity is constructed. The interaction of cultural elements with other domains creates unique local or regional ecosystem configurations. In Isenberg´s theory, each entrepreneurial ecosystem has its own cultural context. Equally, in Stam´s and van De Ven´s (2021, 815) approach culture refers to "*entrepreneurship culture*" that "*reflects the degree to which entrepreneurship is valued in society*". They measure entrepreneurship culture by how common startups are and how society views self-employment and entrepreneurs. Culture is seen as part of informal institutional arrangements. It is embedded in the systemic conditions of the ecosystem. Adapting this to social entrepreneurship, this would reflect how much social enterprises are valued, measuring the prevalence of social ventures and societal attitudes toward social entrepreneurs.

Cohen (2006) views culture as the most critical, foundational and unique, yet least replicable component in the development of entrepreneurial ecosystems. Cohen (2006) defines culture broadly to include the region's environmental features, shared civic knowledge as well as community ethos. Going further, Roy et al. (2015) treats culture in social enterprise ecosystem acknowledging historical legacies. Culture is seen closely tied with political narratives and regional identity. They view culture as one of the forces behind the divergent development of social enterprise ecosystems. Similarly, Roundy (2017) raises the issue of culture's role within a wider context but does not explore it in greater detail; He argues that social ventures are embedded within a web of interconnected influences, and to fully understand their success or failure, researchers and practitioners must recognize the cultural dimensions that shape them. As such, cultural forces influence from the perceptions and valuations of social problems to how social entrepreneurship ecosystem is organized and legitimized (Ibid.)

Yet, scholars underline the need to study the cultural dimensions of social entrepreneurship further for understanding the motivations, practices, and contextual variations that shape how these initiatives emerge and operate across different settings (Weerakoon 2024).

Taking cues from Cohen (2006) and Roundy (2007), this study adopts a more expansive definition. However, it is necessary to define culture more thoroughly in this research because this study specifically focuses on understanding culture dimension in "the social enterprise ecosystem". This study adopts Abramson´s (2012) context-dependent model on culture. This theory synthesizes research on culture, acknowledging diverse elements of culture that influence action. Culture refers to values, resources, motivations and meanings. All these elements in culture influence action in a complex way. Importantly, context matters. (Abramson 2012)

3. Methodology

This study adopts a qualitative interpretative approach to explore the cultural elements embedded in social entrepreneurship ecosystems. Social interaction shapes how social enterprises and their ecosystems are viewed. The data source in this study is EU´s social enterprise ecosystem country reports (European Commission 2018, European Commission 2019a, 2019b, 2019c). The analysis focuses on section "*Background, roots and drivers*" in each of these reports. This section was selected because it best captures the key narratives and motivations shaped by cultural factors. The countries chosen are Finland, Sweden, Estonia and Latvia. These Baltic and Nordic countries represent diverse backgrounds. These reports use institutional, official types of narratives and are created by experts in certain contexts. They use a shared definition for social enterprises. Looking at the language they use helps reveal what cultural elements are shown.

These reports describe social enterprise ecosystems at the country level. At the same time, according to ideas of the constructivist paradigm, they also actively reproduce and shape the ideas of social enterprise ecosystem. Knowledge is constructed through interpretation. Data gains meaning when viewed through different perspectives (Fischer 2003). Analyzing how cultural elements are represented in policy documents provides new perspectives on the role of culture in ecosystem dynamics.

Content analysis is a suitable method for analyzing policy documents in entrepreneurship and management research (e.g., Horne et al., 2020; Groenland & Dana, 2020). The analysis in this study progresses iteratively: After first, broad reading of reports the scope of this study's focus is deliberately delimited. The first reading helps identifying how culture is described in each policy document. This step involves a thorough review of each document to extract descriptions of cultural elements. The second reading analyzes how cultural meanings, resources and motivations are described in detail. These are coded. The third reading cross-analyzes these codes and categorizes them into themes. The themes are identified based on their prominence in the policy documents. To validate these themes, the documents are carefully checked and reread multiple times, ensuring that recurring elements are consistently recognized and accurately represented. The interpreted themes describe what type of cultural element categories are presented as relevant in a sample of social enterprise ecosystem country reports.

4. Findings

First, cultural elements interpreted in the report by individual countries are presented. After that, cross-analysis and thematic categorizing are presented.

4.1 Cultural Meanings, Resources, and Motivations in the Finnish Social Enterprise Ecosystem

The term "social enterprise" is relatively new in Finland. However, the social enterprise ecosystem has roots in traditions of cooperatives and associations emphasizing collective self-help. These are associated with social justice, and ethical entrepreneurship. The Finnish social enterprises represent all types of organization forms. Lessons shaping cultural meanings of social enterprises are also drawn from international experiences.

A key driver is the need to address gaps in welfare provision. The report notes that the trend of delivering public services through quasi-markets has steadily risen, with a clear shift from public to private provision of social services. Social enterprises are seen as partners to the public sector, and they address service gaps particularly in rural areas. Workforce challenges in the social and health care sectors, especially in Finland's sparsely populated areas, illustrate how cultural resources shape the development. Difficulties in recruitment and staff motivation also reflect cultural tensions around the perceived value of care work. Care sector social enterprises

have role in these cultural dynamics in Finland, influencing in the value of care work and accessibility of services in rural areas.

One of the drivers for social enterprises is described as promoting labor market inclusion. Work integration enterprises represent the most institutionalized category of social enterprises. At the time of the report, the Social Enterprises Act applied to work integration enterprises and this is mentioned. Access to European funding is mentioned as well.

4.2 Cultural Meanings, Resources, and Motivations the Swedish Social Enterprise Ecosystem

Although the term "social enterprise" is relatively new, Sweden's tradition of social initiatives is described to be rooted in democratic and labor movements. Well established non-profit sector has reflected the cultural understanding of the purpose and legitimacy of civil society in Sweden.

Swedish social enterprises blend cooperative, nonprofit, and business logics, framed within a welfare model where they complement public services. There is a cultural shift towards more marketization of welfare. In the field competition, choice, and market principles are new normal. "Competitive neutrality" suggests a cultural shift toward diversity of providers what was earlier more clearly public services. Civil society actors are no longer considered as activists or advocates, they adapt more entrepreneurial models. Terms like social enterprise and social entrepreneurship indicate a cultural blending of business logic with social purpose. Cultural motivations include maintaining access to welfare services, solving societal problems and serving humanitarian values, seizing opportunities within public service markets, and defending social value logics against commercial pressures.

4.3 Cultural Meanings, Resources, and Motivations in the Estonian Social Enterprise Ecosystem

Estonia's social enterprises draw on traditions of self-organization and civic participation while distancing themselves from negative Soviet era associations with forced collectivism. During the Soviet period, forced collective labor created deep distrust toward collaboration and collective entrepreneurship in Estonia. Cooperatives became associated with coercion and loss of autonomy, giving them a negative cultural association. The most common legal form for social enterprises and civic initiatives is the non-profit association.

Cultural reorientation in Estonia has used historic cultural resources of mutual aid, new social initiatives and civic participation and EU influences. The report mentions the EU accession in 2004, the introduction of the concept of social enterprise after 2005. At first the concept of social enterprise was considered unclear and elitist. Institutional cultural resources have supported ecosystem development. The establishment of supportive structures like the Estonian Social Enterprise Network in 2012 further supported motivations for building social enterprise ecosystem. The rise of social enterprises in Estonia reflects the activation of civil society as a cultural resource. There is a motivation toward autonomy, community-building, and democratic involvement. Social enterprises also fill in welfare gaps. The welfare model has been transitioning towards Nordic models. Social enterprises are diverse and emphasize transparency and local ownership in their operations.

4.4 Cultural Meanings, Resources, and Motivations in the Latvian Social Enterprise Ecosystem

Latvia's ecosystem builds on a tradition of civic activism rather than cooperative models, reflecting post-Soviet skepticism towards collectives and profit-driven enterprises. Social enterprises are culturally tied to values of altruism, solidarity, and community benefit. Historical association structures, evolving legal frameworks, early foreign donor support, and EU funding shape the resource environment. Organizations must navigate complex legislation and increasingly focus on sustainable financing. Latvian social enterprises are driven by the desire for improved living conditions, ethical entrepreneurship, government gaps in welfare provision, and the need for sustainable income models post-foreign donor withdrawal. A broader shift toward national self-reliance after EU accession also inspires social enterprise ecosystem development.

4.5 Thematic Categories and Cross-country Comparison

Based on the country reports, the following themes are interpreted to be influential higher categories or clusters for understanding cultural elements.

The first theme, the welfare state model, is a critical context with varying influence across countries. In Sweden and Finland, with publicly funded but transitioning welfare states, social enterprises function as complementary

entities, addressing gaps or innovating at the margins. Social enterprises here focus on enhancing existing structures rather than replacing them. After gaining independence, Estonia and Latvia had weaker welfare systems, so social enterprises emerged to meet important service needs. Social enterprises functioned as filling service gaps in the welfare system.

The second main group for cultural elements is the history of cooperatives and associations in each country. Reports highlight that Finland and Sweden possess an appreciated history of cooperatives, associations, and collective movements. This is seen to play a role in supporting modern social enterprise development. In Finland and Sweden historical infrastructures of collaborative action serve as cultural elements that support social enterprise ecosystem and help legitimizing social entrepreneurship. While Finland and Sweden build on longstanding traditions of cooperative action, Estonia and Latvia had to engage in a process of reinterpretation and reconstruction of collective action. This process aimed to culturally legitimize cooperation once more, separating it from its coercive Soviet era connotations, and re-establishing it as a voluntary, community-driven practice.

Thirdly, one key theme to understanding culture is the role of institutions. Historical views on entrepreneurship show different cultural paths: In Finland and Sweden, entrepreneurship has developed mainly positively, being seen to benefit the community and drive innovation. Entrepreneurship is closely tied to values of social responsibility and progress, showing a strong belief in its ability to benefit society. In Estonia and Latvia, however, the post-Soviet perception of entrepreneurship was initially negative, associated with corruption, profiteering, and opportunism. Social enterprises in these countries had to actively challenge these stereotypes, rebranding entrepreneurship as ethical and mission driven. This reflects a cultural effort to distance entrepreneurship from its exploitative, post-Soviet associations and reframe it as a tool for social good.

The role of institutions is the fourth main category for understanding cultural elements. Institutional environment refers to legislation, cooperative advisor services, structured funding mechanisms and any institutions that secure a role of social enterprises in the ecosystem. All country reports refer to these. All sample country ecosystems interact with other country ecosystems and get influences from them. Importantly, EU accession and targeted programs (e.g., EU structural funds, establishment of national networks) have been critical catalysts in building formal support infrastructures. These influences are underlined more in Estonian and Latvian reports.

Finally, values and norms are an overlapping theme. In Finland and Sweden, social enterprises are shaped by stable values of democracy, equality, and solidarity, which have evolved by integrating modern business practices with traditional collective action. In contrast, Estonia and Latvia experienced skepticism toward collectivism due to their Soviet past, but have gradually rebuilt values like trust, transparency, and civic engagement, emphasizing grassroots, bottom-up activism. While Finland and Sweden have hybridized their values with business methods, Estonia and Latvia have consciously reconstructed their values, focusing on local, community-driven efforts.

Table 1: Cultural aspect clusters in social enterprise ecosystems

Cultural aspect cluster in ecosystem	Welfare and institutional models	History of cooperatives and associations	Views of entrepreneurship	The role of institutions	The overlapping theme: values and norms
Description	Cultural expectations on the role of the state and public and other service providers	How collective organizing is perceived and what type of institutional arrangements and collaboration patterns are valued	Embedded values and cultural experiences related to entrepreneurship, what kind of enterprises are valued or stigmatized, how enterprise, social enterprise and impact are defined	Institutional programs Laws, regulations and codes Funding Networks	What is seen as valuable, ethical, legitimate

5. Discussion

In the reports culture is not directly defined, but interpreted themes welfare model changes, history of entrepreneurship, co-operatives and associations carry, values and norms cultural weight. All country reports comment that social enterprises are a new or relatively new phenomenon, yet their roots can be traced back to local initiatives where people created wellbeing.

By examining these cultural elements, the reports shed light on the local dynamics that drive social enterprise models, emphasizing the importance of context in shaping their success, goals, and relationships with institutional structures. The historical and cultural roots explain why some elements are trusted or mistrusted. In Estonia and Latvia, the economic traditions were disrupted and therefore building ecosystem is a different cultural shift. Trust and legitimacy issues can be interpreted to be more sensitive in Estonia and Latvia. For example, in Finland and Sweden, cooperatives are appreciated, in Estonia and Latvia, they are culturally sensitive topics because under Soviet perestroika, cooperatives became associated with corruption. In Estonia and Latvia social enterprise ecosystem is described to be influenced more from EU social economy goals.

Although the cultural elements can be traced back to historical changes and evolution, the EU level discourses on social enterprises are influential in all four country reports. Within this discourse, all country reports note that all four countries demonstrate a move toward hybrid models that blend social value creation with entrepreneurial methods. Social enterprises respond to welfare model transition and cultural perceptions of ethical business and societal needs. In Finland and Sweden, strong welfare states allow social enterprises to complement public services. Social enterprises are culturally associated with ethical entrepreneurship and democratic values. In Estonia and Latvia, weaker post-Soviet safety nets led to social enterprises focusing on community resilience and distancing from collectivism. Notably, terms such as “collective” or “social economy” are culturally interpreted differently depending on historical experiences.

5.1 Theoretical Contribution

Whereas the EU synthesis report (2020) integrated views from country reports, this study has provided a more detailed and fine-grained cross-country analysis by utilizing the theoretical perspectives of entrepreneurial ecosystems and specifically a cultural lens to them. In doing so, the present study contributes to literature on entrepreneurial ecosystems and social entrepreneurship in the European context, by showing how a broader cultural lens to entrepreneurial ecosystems and social enterprise ecosystem studies can be applied and integrated. Although culture is often mentioned in literature on entrepreneurial ecosystems and social entrepreneurship in general, research until now has tended to neglect engaging with it in depth or to consider its construction at the cultural level specifically. By adopting a broader definition of culture, inspired by Cohen (2006) and Roundy (2007), and applying Abramson's (2012) context-dependent model, the present study contributes to the literature from this perspective; This model specifically emphasizes how values, resources, motivations, and meanings shape actions, highlighting the importance of context in understanding cultural influences within the social enterprise ecosystem. The approach to culture differs from prior entrepreneurial ecosystems studies that have positioned culture alongside policy, finance, support systems, human capital and markets (Isenberg 2010). This study argues culture in social entrepreneurial ecosystems could be studied viewing culture as overarching and inseparable dimension, from a more heuristic point of view. This way of thinking sees social entrepreneurship and their ecosystems as shaped by multiple, emergent, complex and interdependent layers of context. The role of welfare systems, perceptions of entrepreneurship, institutions, values are key categories shaping culture in social entrepreneurial ecosystems. Future studies are encouraged to adopt a heuristic approach to enable nuanced exploration of social entrepreneurial ecosystems and their evolving cultural dynamics.

5.2 Practical Implications

Understanding social entrepreneurship as a socially constructed practice highlights the value of shared communication, learning and exchanging practices. Recognizing the ways people locally give and make sense of meaning is essential for crafting actions that participants want to engage in. Culture sensitive knowledge is useful in aligning initiatives with local cultural expectations.

Policymakers can design support measures that are aware of cultural elements and support evolution of social enterprise ecosystems appreciating local cultural elements. In Estonia and Latvia, policies might benefit from fostering mission-driven models and supporting community-rooted initiatives. In Finland and Sweden, there

could be value in reinforcing the integration of ethical business practices within existing welfare structures. But more research in this area is needed. Appreciating diversity may play a crucial role in facilitating inclusive growth that corresponds to the varied contexts across Europe.

5.3 Limitations and Future Research

While the study provides insights into how culture is framed in the selected documents, it is important to recognize that these documents only offer a partial view of the cultural dynamics in question. The study relies on official documents. This shapes interpretation. The documents or this analysis are not able to capture the real-life complexity and informal side of the cultural nuances. However, the insights gained from these documents still offer important perspectives on the institutional framing of culture.

To truly understand the living culture of social enterprising, both from the grassroots and from institutional levels, there is a need to study more with empirical, qualitative approaches. Future studies could investigate countries' welfare systems as ecosystems and shed light on the diversity of dynamic systems where social enterprises play a role. Abramson´s (2012) context dependent model on culture can provide a foundation for investigating the questions of how and where more, and how some of the cultural element's influence in action differently in diverse social enterprise contexts. There is a need to better understand the different aspects of social enterprise ecosystems, including individual motivations, norms, values, and attitudes, as well as skills, welfare model dynamics, and the interactions between the public, private, and third sectors. Expanding this knowledge supports social value creation while addressing contextual challenges and opportunities.

Ethics Declaration

No sensitive data were collected, and all procedures met ethical standards.

AI Declaration

Chat GPT was used for grammar checking.

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Empowering Malaysian Women Entrepreneurs in Small Enterprises Through Institutional Support

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Abstract: Women-owned small businesses are essential to Malaysia's socio-economic growth. However, they face challenges such as limited access to funding, education, and industry connections. Although institutional support is available, it often lacks a gender-focused approach and does not fully address the unique struggles women entrepreneurs face, particularly within patriarchal cultural systems and male-dominated industries. This study explores how institutional support can empower women entrepreneurs by using institutional work theory through the aspects of create, maintain, and disrupt to examine how formal and informal systems help them succeed. Through a detailed review of academic research, policy documents, and international case studies, this study is a conceptual paper that identifies key gaps in financial aid, mentorship, training, and networking opportunities. It compares Malaysia's efforts with global best practices to highlight areas that need improvement. The findings show that women entrepreneurs require targeted, gender-specific programs to overcome the barriers they face. Many existing programs do not consider the social and structural challenges that make it harder for women to grow their businesses. Beyond financial support, this study highlights the importance of mentorship, policy changes, and skills training in promoting gender equality and inclusive economic growth. These elements are crucial for helping women entrepreneurs succeed and expand their businesses. Additionally, this study calls for policy reforms that focus on gender-inclusive strategies within Malaysia's entrepreneurial ecosystem. By closing the gap between available support and the real needs of women entrepreneurs, this research offers practical recommendations for policymakers, business leaders, and support organizations. Strengthening institutional frameworks will not only help women entrepreneurs but also drive economic progress and sustainable development in Malaysia. Overall, this study emphasizes the need for a more inclusive and structured approach to supporting women entrepreneurs. By aligning policies with global best practices, Malaysia can create a fairer and more supportive business environment, allowing women entrepreneurs to thrive and contribute more effectively to national development.

Keywords: Institutional Support; Women Entrepreneurs; Gender-focused; Entrepreneurial Development; Sustainable Economic.

1. Introduction

According to Darnihamedani and Terjesen (2022), there is evidence indicating that women-owned firms demonstrate higher rates of both business growth and job growth than enterprises held by men. Like other small business owners, women entrepreneurs had to face the possibility of a high failure rate despite this growth rate and economic impact. Gender bias and a lack of support targeted at women entrepreneurs are two major obstacles they face (Md Isa et al., 2018). Ahmad and Ali (2024) and Md Isa et al. (2018) emphasised the need for stakeholders to focus on implementing sustainable business management practices and addressing the important discussions around policies supporting women-owned enterprises' growth.

Research has found that institutional support, such as from government agencies or non-governmental organizations (NGOs), is associated with reducing gender disparities among small business owners. Specifically, this support is linked to narrowing the gaps between men and women in terms of the size of their businesses and their aspirations for growth (Basit et al., 2020). The Malaysian government has allocated RM230 million in Budget 2022 to support women entrepreneurs and facilitate the growth of their enterprises (MOF, 2021). Given the substantial financial support offered, the success of women entrepreneurs is of paramount significance.

Nevertheless, small businesses in Malaysia encounter challenges in maintaining their existence, with many ceasing operations during the initial five years (Ambad et al., 2020). Identifying the availability of assistance programs for small firms, especially those run by women, is challenging, and the financial resources provided to them are often inadequate (Ariffin et al., 2020). Hence, the sustainability of small firms owned and controlled by women entrepreneurs is compromised due to gender bias and a lack of entrepreneurial leadership (Adom & Anambane, 2020).

Razak et al. (2024) have reported that women entrepreneurs in Malaysia exhibit a higher propensity for starting businesses than men. However, their study also addressed the obstacles encountered by women entrepreneurs in advancing their businesses to a more advanced level. The current situation has strengthened the points made by Ariffin et al. (2020) that women entrepreneurs require a supportive environment to ensure the long-term viability of their businesses, which, in this context, refers to practical institutional support. Ariffin et al. (2020) added that institutional support is a crucial component of a supportive system that women entrepreneurs need to have in order to successfully manage gender-specific challenges and align their strategies with emerging business trends.

2. Literature Review

Institutional support helps women entrepreneurs bridge resource gaps, enhance competitiveness, and achieve long-term success (Zaato et al., 2023). Its primary aim is to foster a supportive entrepreneurial environment (Ariffin et al., 2020). Kazumi and Kawai (2017) identified formal and informal support as key components of institutional assistance. Xie et al. (2021) also emphasized these categories in their study.

2.1 Formal Institutional Support

Institutional support is essential for empowering women entrepreneurs, but its effectiveness depends on targeted and well-coordinated measures, as highlighted by various studies. Kazumi and Kawai (2017) and Xie et al. (2021) identify key areas where formal institutional assistance provides substantial benefits, such as financial systems (grants, subsidies, and loans), educational resources (training and technical guidance), and government policies (gender equality measures and tax incentives). These supports create foundational resources that enable women to overcome systemic barriers and pursue sustainable business ventures. However, the scope of institutional support varies in its effectiveness depending on its alignment with the specific needs of women entrepreneurs.

In Malaysia, Bakar et al. (2020) identified significant gaps in institutional support, particularly in access to financial resources, which are critical for business growth. Women entrepreneurs often face significant challenges in securing business funding, including discrimination from financial institutions and complex loan procedures. A lack of initial capital can have long-term negative effects, as it limits their ability to produce new products, create jobs, or sustain their ventures (Bakar et al., 2020). Financial institutions often hesitate to provide large loans to women entrepreneurs, citing a lack of confidence in their business capacity. Even when loans are granted, short repayment periods and high interest rates create additional challenges, particularly since establishing a business typically takes at least a year. Furthermore, banks prefer funding businesses with a minimum two-year operational history, limiting opportunities for women in the start-up phase (Bakar et al., 2020).

Noor and Isa (2020) further highlight the role of government policies in creating an enabling environment for women entrepreneurs. Policies promoting gender equality, tax relief, and access to markets can make business opportunities more accessible. Noor and Isa (2020) also emphasize the value of mentorship programs and networking opportunities, which provide women with guidance from experienced professionals, enabling them to share knowledge, gain insights, and navigate challenges in their businesses. These relational supports complement traditional institutional measures by fostering confidence and practical skills.

In a complementary view, Ariffin et al. (2020) emphasize the need for inclusive policies to address structural barriers and promote gender equality in Malaysia. Their study calls for legislative measures that ensure equal access to resources, networks, and financing while addressing disparities in representation and opportunity. Such measures are essential for creating a fair and supportive environment for women entrepreneurs, enabling their active participation in the economy.

Regulatory frameworks also play a significant role in supporting women's entrepreneurial success. Yousafzai et al. (2015) argue that gender equality legislation and work-life balance policies empower women and enhance their leadership in business. Kazumi and Kawai (2017) add that interactions with government business officers help women entrepreneurs build confidence and establish formal networks, bridging the gap between policy and practical outcomes.

Historically, Malaysia has made notable progress in institutionalizing support for women entrepreneurs. During the Eighth Malaysia Plan (2001-2005), the government began incorporating women's business involvement as a national objective (Mokhtar, 2020). Bank Negara Malaysia (BNM), through its subsidiary, the Credit Guarantee

Corporation Malaysia Berhad (CGC), introduced a scheme to provide financing guarantees for women unable to secure loans from traditional institutions (Rashid, 2017).

Since then, government support has expanded through initiatives like the Tenth Malaysia Plan (2011-2015) and the Twelfth Malaysia Plan (2021-2025) (Rashid, 2017; UNDP, 2023). The latest plan focuses on empowering women entrepreneurs to promote gender equality and enhance their participation in the economy through initiatives like the sharing economy and entrepreneurship development (UNDP, 2023).

However, institutional support is not uniformly effective across all areas for women entrepreneurs. For instance, Kazumi and Kawai (2017) found that formal institutional support had minimal impact on enhancing women's entrepreneurial self-efficacy. Similarly, Orobia et al. (2020) revealed that while access to capital and IT infrastructure significantly improves the sustainability of women-owned businesses, other forms of support, such as general education and broad government initiatives, demonstrated limited effectiveness. These findings highlight the need to prioritize high-impact areas of formal support like financial aid and digital infrastructure while acknowledging the influence of contextual factors such as geography and cultural norms on the success of support initiatives.

2.2 Informal Institutional Support

Informal institutional support, defined as unwritten social norms, values, traditions, and networks within a society, is a critical enabler for women entrepreneurs. Unlike formal institutions governed by laws and regulations, informal systems operate through social practices and interpersonal connections that influence entrepreneurial activities (Giménez & Calabrò, 2018). These institutions shape how women identify opportunities, access resources, and develop self-efficacy, which is a crucial element for entrepreneurial success. According to Harahap and Muchtar (2021), such support enables women to build networks, gain confidence, and overcome societal stigmas, encouraging them to take risks and initiate business ventures. Such support includes mentorship, peer networks, and community-based guidance, which foster trust, collaboration, and shared knowledge essential for business growth (Saleem et al., 2024).

However, women entrepreneurs often face unique challenges, such as balancing domestic responsibilities with business demands and navigating societal norms that question their leadership roles. Providing culturally sensitive solutions, like childcare facilities, could alleviate these burdens (Bakar et al., 2020). In Malaysia, associations like Persatuan Wanita Bumiputera Dalam Perniagaan dan Profesyen Malaysia (Peniagawati), the Women's Wing of the Malay Chamber of Commerce Malaysia, the Federation of Women Entrepreneurs Association Malaysia (FEM), and the National Association of Women Entrepreneurs of Malaysia (NAWEM) play a pivotal role in empowering women by offering skills training and creating platforms for collaboration (Rashid, 2017). Nevertheless, the absence of broader societal legitimacy and recognition can stifle entrepreneurial ambition, particularly in societies where gender stereotypes prevail (Muñoz & Kibler, 2016). Therefore, cultivating a "one-is-not-alone" culture, where entrepreneurial visions are legitimized and admired, is essential to increasing women's participation in economic activities (Kazumi & Kawai, 2017). A deliberate focus on informal institutional support not only enhances women's self-efficacy but also creates a more inclusive and resilient entrepreneurial ecosystem.

Giménez and Calabrò (2018) identified five key types of informal institutional support that are particularly relevant to women entrepreneurs: gender, social norms, family, religion, and codes of conduct. Table 1 below summarizes these types, detailing their definitions and roles in empowering women entrepreneurs, as outlined in the work of Giménez and Calabrò (2018).

Table 1: Key Types of Informal Institutional Support

Informal Institutional Support	Definition	Roles
Gender-focused	A social construct that differentiates between men and women in society.	Women entrepreneurs shape their identity based on societal gender roles, which influence their motivations, career choices, and family dynamics. *Challenges:* Masculine gender roles can create barriers in male-dominated industries like high-tech, hindering women's participation and success.

Informal Institutional Support	Definition	Roles
Social norms	Social norms are shared beliefs that influence entrepreneurial attitudes and perceptions differently for men and women.	Gender stereotypes shape societal expectations, which can affect women's opportunities and access to start-up capital. *Challenges:* The media often portrays a masculine view of entrepreneurship by stereotyping and underrepresenting women entrepreneurs.
Family	A social structure and networks within a family unit that provide emotional, financial, and practical assistance to women entrepreneurs.	Family support helps women achieve work-family balance, positively impacting their venture performance. Women entrepreneurs are often driven by necessity, focusing on ventures with social and environmental value and seeking flexibility for family needs. *Challenges:* Women face difficulties managing both roles, particularly as their businesses grow.
Religions and ideologies	Religions and ideologies help explain aspects of society and culture, influencing the environment in which women entrepreneurs operate.	Religious and ideological norms influence women's entrepreneurial behaviours. Islamic values can motivate Muslim women to pursue business excellence. *Challenges:* In countries like Pakistan, traditional gender roles and mobility restrictions limit women's entrepreneurship.
Codes of conduct	Codes of conduct are unwritten rules that shape daily interactions and influence individual behaviour in economic, family, and organizational contexts.	Empowering women entrepreneurs involves increasing their awareness and learning from their environment. 1. Women benefit from being part of networks, with their businesses showing positive growth. 2. In male-dominated industries (e.g., high-tech, construction), women tend to have high self-efficacy and economic expectations, while in traditionally female industries (e.g., retail), they focus on work-family balance. 3. Women with high growth intentions are typically highly educated and motivated by financial success, self-realization, and recognition. *Challenges:* Women entrepreneurs may face pressure balancing high growth expectations, financial success, and family life.

3. Methodology

This study reviews institutional support for women entrepreneurs through a systematic literature review using Google Scholar (2014–2024). Keywords included "institutional support," "women entrepreneurs," and "small enterprise sustainability." Articles were selected based on relevance, peer review, and citation count, while studies lacking a gendered perspective or methodological rigour were excluded.

Additionally, the study analyzes official documents, academic reports, and government policies on women's entrepreneurship in Malaysia. This provides insight into the evolution of institutional support, highlighting key initiatives and strategic priorities aimed at empowering women entrepreneurs.

4. Conceptualizing Women Entrepreneurs' Empowerment Using Institutional Theory

According to Franco and Franco (2022), institutional theory is a broad and important framework that has developed as a result of the combined efforts of numerous academics and researchers over many years, such as Meyer and Rowan (1977), DiMaggio and Powell (1983), and Scott (2014). Institutional theory is a multidisciplinary approach since it originates in several academic disciplines rather than being the invention of a single person (Franco & Franco, 2022). This theory explores formal and informal institutions' role in influencing the actions of people and groups in society (Giménez & Calabrò, 2018). This theory has gained acceptance and respect in disciplines like sociology (Carvalho et al., 2017) and political science (Ilonszki, 2022), in which it has clarified the intricacies of institutional contexts and their effects on numerous aspects of interpersonal communication and organizational behaviour.

Coates et al. (2023) referenced Cai and Mehari (2015); there are three stages in the evolution of institutional theory: "Old Institutionalism Theory," which emerged at the end of the 1940s; "New Institutionalism Theory,"

which developed at the end of the 1970s, and a variety of "New Perspectives," which have been developing since the 1990s.

Within the context of women entrepreneurs and empowerment, modern institutional theory, also known as "new perspectives", offers valuable insights, particularly through the concepts of institutional logics and institutional work.

4.1 The Insights of Modern Institutional Theory

In examining women entrepreneurs' empowerment, selecting institutional theory as the overarching framework can substantially impact the comprehensiveness and applicability of the study. Table 2 below shows the insights of modern institutional theory, outlining its focus, structural perspective and their applications.

Table 2: The Insights of Modern Institutional Theory

Institutional Theory	Focus of Theory	Structural Perspective	Source
Institutional Logics	Coexistence of multiple logics influencing behaviour at structural and macro levels.	Conflict resolution: Addresses competing logics in a stable framework. Relevant in studying how entrepreneurs balance diverse logics in their business operations.	Ponte and Pesci (2022)
Institutional Work	Social actors' influence on institutions.	Agentic: institutions could be changed by actors through creation, maintenance and disruption. The agency-focused theory is ideal for understanding how entrepreneurs actively adapt institutions for their benefit.	Beunen et al. (2017)

Institutional logics and institutional work offer complementary perspectives on business sustainability in women's entrepreneurship.

Institutional logics, introduced by Friedland and Alford (1991) and refined by Thornton et al. (2012), define the principles and norms shaping decision-making (Mutch, 2021). Societal expectations, gender roles, and structural challenges influence women entrepreneurs' experiences (Glaser et al., 2016). Navigating competing demands, such as balancing family roles and business ambitions, remains crucial for sustainability (Schildt, 2022). Aligning profit, social responsibility, and environmental goals enables women entrepreneurs to build sustainable ventures (Perkmann et al., 2019).

Institutional work, introduced by Lawrence and Suddaby (2006), shifts the focus to individual agency in shaping or transforming institutions (Lawrence et al., 2013). Women entrepreneurs actively challenge gender norms, advocate for policy changes, and promote sustainability (Kaartemo et al., 2020). Unlike institutional logics, which highlight structural constraints, institutional work emphasizes dynamic efforts in reshaping business landscapes.

Highlighting women entrepreneurs' agency provides a strong framework for understanding their role in driving sustainability, influencing policy, and overcoming systemic barriers. This study adopts institutional work as a key lens, emphasizing the proactive role of women entrepreneurs in advancing sustainable business practices (Beunen et al., 2017; Lawrence et al., 2013).

4.2 Empowering Women Entrepreneurs Through Institutional Work

The concept of institutional work emphasizes the active role of individuals and organizations in shaping and influencing institutional structures (Gidley & Palmer, 2021). This perspective is particularly relevant to the business sustainability of small enterprises owned by women, as these businesses are not passive recipients of institutional pressures but active agents capable of initiating and driving change.

By applying institutional work, this study explores how small enterprises owned by women entrepreneurs can actively engage with sustainability-related institutions and contribute to the evolution of sustainability standards

and practices. The institutional work framework provides a lens to understand the dynamic interplay between entrepreneurial actions and institutional transformation.

Institutional work operates through three core dimensions: creating, maintaining, and disrupting elements (Beunen et al., 2017). These elements play a crucial role in empowering SWEs and fostering sustainable business practices. Integrating these components into strategic institutional support initiatives can effectively enhance the growth and sustainability of women-owned enterprises. Figure 1 illustrates the application of institutional support in empowering women entrepreneurs towards their business success.

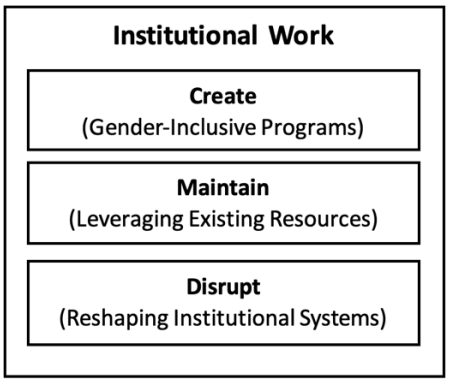


Figure 1: Institutional support elements (Adopted from Beunen et al. (2017) and Giezen (2018))

4.2.1 Create

The "create" component of institutional work, as defined by Beunen et al. (2017), involves establishing programs, norms, and policies that drive positive change. For Malaysian women entrepreneurs in small enterprises, this phase is crucial for promoting gender equality and business sustainability. Given persistent gender biases and structural barriers, strategic institutional support can help reshape the entrepreneurial landscape, fostering long-term success (Ariffin et al., 2020).

While formal institutional support, such as government policies and structured programs, plays a key role, its effectiveness must be critically assessed. Initiatives like TEKUN Nasional's Tekunita Financing Scheme and MARA's Women Entrepreneurs Development Programme (WEDP) provide targeted financial assistance, entrepreneurial training, and market access specifically designed to support Malaysian women entrepreneurs in starting, growing, and sustaining their businesses (Razak et al., 2024). However, without addressing structural challenges such as societal expectations and gender roles, these programs may unintentionally reinforce disparities. To ensure meaningful empowerment, institutional support must be both targeted and holistic, addressing financial and non-financial barriers to success.

4.2.2 Maintain

The "maintain" component of institutional work, as highlighted by Colombero and Boxenbaum (2019), focuses on leveraging existing resources to ensure stability in small businesses. Women entrepreneurs rely on established networks, institutional frameworks, and available resources to sustain growth and navigate systemic barriers such as gender biases, limited capital access, and societal expectations. While maintaining the status quo offers short-term stability, it risks reinforcing structural inequalities. Institutional support is crucial in mitigating these biases and enabling long-term business success.

Predominantly driven by informal mechanisms, the "maintain" phase depends on mentorship, peer networks, and cultural associations Colombero and Boxenbaum (2019). In Malaysia, organizations like the Women Entrepreneurs Network Association (WENA) and the Women's Institute of Management (WIM) provide informal support that strengthens resilience, enhances skills, and fosters community (Rashid, 2017). These networks offer knowledge-sharing and emotional support but may unintentionally sustain power imbalances and fail to address systemic challenges. While informal support is essential, it should complement rather than replace formal institutional support. A balanced approach integrating both ensures a more equitable and sustainable entrepreneurial environment for women.

4.2.3 Disrupt

The “disrupt” phase in institutional work, as outlined by Beunen et al. (2017), focuses on reforming structures that sustain gender inequities, allowing women entrepreneurs in small businesses to overcome systemic barriers. In Malaysia, challenging entrenched norms is crucial for fostering a more inclusive and sustainable business ecosystem. Achieving this transformation requires support from formal and informal institutions, including government agencies, NGOs, and private sector actors, to create an equitable entrepreneurial environment.

Collaboration among multiple stakeholders is essential for meaningful disruption (Kazumi & Kawai, 2017; Orobia et al., 2020). Government policies, grassroots initiatives, and informal networks must work together to dismantle gender disparities. For example, the partnership between UNDP Malaysia and the Ministry of Women, Family, and Community Development showcases a concerted effort to embed gender equity in entrepreneurship policy (UNDP, 2023). Likewise, organizations like Persatuan Wanita (PEWANI) actively work to dismantle patriarchal norms by supporting women entrepreneurs in aligning their business ventures with Islamic values, thus addressing both cultural and religious barriers that hinder their progress (Sahari et al., 2023).

Sustained success in the “disrupt” phase depends on integrating formal and informal support structures. While policies provide financial and structural resources, grassroots advocacy and mentorship programs offer practical guidance and confidence-building. Ensuring inclusivity in these efforts is vital to prevent marginalization and conflicting agendas that may undermine systemic change. Strategic alignment of disruption initiatives is necessary to challenge power imbalances and drive lasting reform.

5. Conclusion

In conclusion, institutional work theory offers valuable insights for empowering women entrepreneurs, particularly those in small businesses in Malaysia. The “create” phase emphasizes the role of formal institutional support, such as gender-inclusive policies and financing programs, in overcoming gender biases and promoting sustainable business practices. The “maintain” phase highlights the importance of informal support mechanisms, like mentorship and peer networks, which provide vital resilience and guidance but must complement formal support to avoid reinforcing gender inequalities. The “disrupt” phase calls for collaborative efforts from both formal and informal stakeholders to challenge and reform institutional structures that perpetuate gender disparities, fostering systemic change for gender equity.

Having said that, empowering women entrepreneurs requires a holistic approach that combines both formal and informal institutional support. By leveraging institutional work theory, women entrepreneurs can better navigate challenges, utilize resources, and engage in collective efforts to drive inclusive and sustainable business growth, creating a more equitable entrepreneurial ecosystem.

This study identifies opportunities for further exploration in several key areas, including evaluating the effectiveness of gender-inclusive policies on business sustainability for Malaysian women entrepreneurs and examining the interplay between formal support systems, such as government programs, and informal mechanisms, such as mentorship and networks, in fostering women’s entrepreneurial success.

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Ethics Declaration

Ethical approval was not necessary for this study, as it did not involve human participants, the collection of personal data, or any interventions requiring oversight from any institutions.

AI Declaration

AI tools were used for language refinement, paraphrasing, and citation formatting, while all conceptual development, analysis, and source verification were conducted by the authors.

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Development and Validation Measures for Green Entrepreneurship and Environmental Sustainability of SMEs in Nigeria

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Abstract: The global emphasis on environmental sustainability has placed pressure on Small and Medium Enterprises (SMEs) to embrace green entrepreneurial practices. Despite increasing global emphasis on sustainable business practices, empirical tools tailored to the Nigerian SME context remain scarce. This research aimed to develop and validate measurement scales that incorporated five proxies of green entrepreneurship (environmental entrepreneurship, green institutional entrepreneurship, and green market appropriating entrepreneurship, green producer-focused and green customer-focused informational entrepreneurship) as well as ecological entrepreneurship of SMEs in Nigerian context. A total of 313 entrepreneurs took part in this research. Data were analyzed through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), by the use of partial least square – structural equation modeling (PLS-SEM) approach. The reliability was achieved through the composite reliability (rho_a and rho_c), outer loading constructs, and cronbach's alpha. The validity was performed through convergent validity which was obtained by measuring the average variance extracted (AVE), while the discriminant validity of the instrument was confirmed through heterotrait-monotrait (HTMT). CR and AVE values showed a satisfactory level to establish measurement model and all values assed to prove discriminant validity achieved the HTMT criterion. Model fit assessment was performed through SRMR and NFI criteria, which confirmed the study's model fit as sufficiently robust to support further analysis. Fundamentally, the development and validation of measurement scale through PLS-SEM has showed that the scales developed in this research are valid and statistically reliable.

Keywords: Green Environmental Entrepreneurship, Green Institutional Entrepreneurship, Green Market Appropriating Entrepreneurship, Green Producer-focused Informational Entrepreneurship, Green Customer-focused Informational Entrepreneurship, Ecological Entrepreneurship, Scale Reliability

1. Introduction

The global shift towards environmental sustainability has led to increased attention on green entrepreneurship, particularly in emerging economies. SMEs play crucial roles in economic development, job creation, and innovation, yet their environmental footprint remains an issue. Green entrepreneurship integrates environmentally sustainable practices into business models, has emerged as vital strategy to address ecological challenges while fostering economic growth. Green entrepreneurship refers to business initiatives that prioritize sustainable practices, resource efficiency, and environmental responsibility (Gupta and Dharwal, 2021). Green refers generally to ideas, practices, or initiatives that prioritize environmental sustainability and aim to reduce negative impacts on the planet (Adeola et al, 2021). Green idea is centred on promoting eco-friendly practices, conserving natural resources, and minimizing pollution and waste generation (Sarkar, at al, 2020).

The environment is the source of all the resources needed by an organization to accomplish its objectives (Xushi Wei et al, 2023). But its negligence has triggered environmental degradation caused by oil spills, erosions and host of other factors that is peculiar to Nigeria environment (Adeola et al, 2021). Sustainability exists as three-legged table consisting of the environment, the economy, and society, or as a dualistic relationship between human-beings and the ecosystem they inhabitate (Chen et al, 2022; Xushi Wei et al, 2023). Environmental sustainability is the rate of renewable resource harvest (Makhulo, 2017), and involves practices that ensure economic activities do not compromise ecological balance (Kaur et al, 2025).

A common blueprint and global call to action, the United Nation in 2015 defined 17 SDGs, which are the cornerstone for SDG agenda. The fact that innovation and entrepreneurship are explicitly mentioned in four of these SDGs highlights their relevance to sustainable development (Adeola et al, 2021). This green agenda aims to transform economic idea generation to involve environmental well-being and social-equity in accordance with SDGs agenda and to achieve the sustainable management and efficient use of natural resources (OECD, 2015; Gyimah et al, 2020; Adeola et al, 2021). SMEs play a critical role in economic development in Nigeria, contributing to employment and local economic growth. However, their activities often have adverse environmental impacts, including pollution, resource depletion, and inefficient waste management (Adedoyin

et al, 2021). While green entrepreneurship presents an opportunity to address these challenges by promoting eco-friendly innovation and sustainability practices, the adoption of such practices among SMEs remain low.

For SMEs to understand how to synchronise the environmental sustainability objectives with their business strategy, green entrepreneurship practices are critical. Example, lack of focus on environmental entrepreneurship, inability to understand the application of green institutional entrepreneurship, unalignment of green market-appropriating entrepreneurship to firm's strategy and environmental objectives, and conversion of producer-focused and customer-focused informational entrepreneurship to green entrepreneurship practices are some problems and challenges faced by SMEs. This empirical research has developed a measurement scale to examine green entrepreneurship and environmental sustainability among SMEs. Addressing these challenges is essential for developing effective policies and support mechanisms to facilitate transition of SMEs from traditional entrepreneurship to a more eco-friendly businesses embedded in green entrepreneurship and environmental sustainability in an emerging economy.

2. Research Objectives

The study broad aim is to develop and validate measurement constructs to assess green entrepreneurship and environmental sustainability of SMEs. The specific objectives are subdivided into the following:

- To develop measure of green entrepreneurship and environmental sustainability (GEES).
- Review current literature in the area of GEES.
- Assessment of unidimensionality, construct reliability and validity, discriminant validity, and model fit.
- Interpretation, final assessment of findings, and contribution to knowledge.

3. Literature Review

3.1 Conceptual Review GEES Constructs.

3.1.1 Environmental Entrepreneurship (GEE)

They are business ventures that incorporate environmental sustainability into their core processes, products, and services (Jiang *et al.,* 2020; Anghel and Anghel, 2022). This involves adopting eco-friendly practices such as waste reduction, renewable energy use, sustainable supply chains, and pollution control. GEE focuses on minimizing the negative impact of business activities on the environment while promoting long-term ecological sustainability (Smaliukienė, and Monni, 2019; Shabbir, 2023; Leal Filho et al, 2025).

3.1.2 Green Institutional Entrepreneurship (GIE)

Involve efforts by businesses or organizations to influence regulatory, social, and institutional frameworks in favour of sustainable practices. Entrepreneurs in this category engage in policy advocacy, industry collaborations, and institutional reforms that encourage green business initiatives (Colwell and Joshi, 2013; Atiase et al., 2018; Herrerera, 2021). GIE plays a crucial role in shaping environmental governance and driving systemic change toward sustainability (Kalyar et al*,* 2020; Zhao et al, 2021; Liu et al*,* 2022).

3.1.3 Green Market-Appropriating Entrepreneurship (GMAE)

Refer to business strategies that capitalize on the growing consumer demand for sustainable products and services (Dean and McMullen, 2007; Cohen and Winn, 2007). Entrepreneurs in this category align their business models with market trends in eco-conscious consumerism, leveraging green branding, certification (e.g., organic or carbon-neutral labels), and sustainability-driven product innovations to gain a competitive advantage (Nordin and Hassan, 2019; Aljuwaiber, 2021).

3.1.4 Green Producer-Focused Informational Entrepreneurship (GPFIE)

Involve disseminating sustainability knowledge and best practices among producers, suppliers, and industry stakeholders (Dean and McMullen, 2007; Cohen and Winn, 2007; Zhao et al, 2021). This includes training programs, workshops, and advisory services aimed at helping producers adopt green technologies, eco-friendly production processes, and sustainable resource management techniques (Zhao et al, 2021; Liu et al*,* 2022).

3.1.5 Green Customer-Focused Informational Entrepreneurship (GCFIE)

It is centred on educating and influencing consumers to adopt environmentally friendly behaviours and make sustainable purchasing decisions (Dean and McMullen, 2007; Cohen and Winn, 2007). This includes green marketing campaigns, eco-labelling, consumer awareness programs, and initiatives that inform customers about the environmental impact of their consumption choices. Businesses using C_FIE leverage consumer engagement to drive demand for eco-friendly products and services (Liu et al*,* 2022).

3.1.6 Ecological Entrepreneurship (ECO_ENT)

Refer to business activities that are inherently designed to promote environmental sustainability by addressing ecological challenges (Clifford and Dixon, 2006). Unlike conventional businesses that integrate sustainability as a secondary goal, ecological entrepreneurship businesses prioritize ecological conservation, restoration, and sustainable resource use as their core mission (Mieszajkina, 2016). Examples include renewable energy ventures, circular economy start-ups, and businesses focused on biodiversity conservation.

The six scales: EE (Jiang et al, 2020; Anghel and Anghel, 2022); GIE (Colwell and Joshi, 2013; Kalyar et al, 2020; Liu et al, 2022); GMAE; GPFIE; GCFIE (Dean and McMullen, 2007; Cohen and Winn, 2007; Nordin and Hassan, 2019); and ECON_ENT (Clifford and Dixon, 2006; Mieszajkina, 2016) were all assessed and extensively developed by the researcher after thorough review of literature.

3.2 Theoretical Framework

This research is anchored on triple bottom line (TBL) theory. A sustainable framework that measures a business success on three core dimensions: economic, social, and environment (Elkington, 2013). TBL has been recognized because it encourages firms to go past traditional financial accounting to take account of ecological and societal considerations in their decision-making practices. Xushi Wei et al, (2023), notes the combination of the three dimensions of TBL theory can help explain the way organizations could go green, partake in eco-friendly activities and understand the incentives available when organizations cultivate green entrepreneurship practices. TBL theory has confirmed both the short and long term incentives of the association between entrepreneurship and the three essentials of an organization's sustainable development (Dhahri and Omri, 2018). TBL theory provides a comprehensive justification for evaluating how SMEs can balance economic viability, social responsibility, and environmental values (Sun et al., 2020). The TBL theory provides a theoretical foundation for categorizing, validating, and operationalization of constructs used to assess green entrepreneurship and environmental sustainability. The researchers used the TBL theory to suggest that enhancing economic viability (i.e. market appropriating entrepreneurship) of organizations is not enough, rather entrepreneurs should increase focus on organization's social responsibility (i.e. green producer-focused and customer-focused entrepreneurship) and environmental values (i.e. environmental, ecological, green institutional entrepreneurship). In this context, the TBL theory is instrumental to provide a balanced-integrative framework that justifies the importance of developing measures to validate green entrepreneurship and environmental sustainability (Usman et al, 2021; Chen et al, 2022). It underscores the need to promote eco-friendly and socially responsible business practice amongst SMEs in Nigeria, at the same time not to lose focus on their financial sustainability. As such, TBL theory enriches both the theoretical grounding and practical significance of this study (Sun et al, 2020; Xushi Wei et al, 2023).

4. Methodology

The researchers adopted a quantitative research design with emphasis on development and validation of survey instrument. The main objective was to develop, test, and validate measurement scales for assessing green entrepreneurship practices and environmental sustainability of SMEs. The study design was arranged in two main parts: development and validation, which includes both exploratory and confirmatory approaches. The researchers made use of a deductive research approach, grounded in theoretical exposition from existing literature on green entrepreneurship, environmental sustainability, and SMEs management and followed a structured step of: item generation, scale development, empirical testing, statistical validation and model fit assessment. In addition, this study adopted a multistage sampling method and was conducted in South-East, Nigeria. Five innovation districts were selected through a random sampling method. The researchers selected few SMEs that promote green entrepreneurship from the innovation districts for the pilot study. Finally, purposive sampling was adopted to select SMEs that promotes green entrepreneurship to meet the requirement of the study. These SMEs have similar characteristics and maintain international standards required by Climate

Action for Africa. The most desirable sample size determination method for PLS-SEM research should be based on power analysis to ensure guaranteed results and a model that can be generalized (Hair, Hult, et al, 2017). The minimum sample of this study was calculated using Krejcie-Morgan formula based on specific features and sample size recommendation in PLS-SEM for a statistical power of 80%. Based on calculations, a total of 212 minimum sample numbers in reference to PLS-SEM were proposed for this study (Hair, Hult, et al, 2017). Previous research recommended that 100 to 200 samples are adequate to serve as starting point for research related to path estimation, particularly PLS-SEM (Mohd Dzin et al, 2021). To meet the requirement, the researchers collected data from 313 samples. Theses samples were measured to be homogenous as they operate within the innovation district clusters within South-East, Nigeria and they use the same standard of operation required by Climate Change for Africa.

4.1 Method of Analysis

The researchers adopted Partial Least Square-Structural Equation Modelling (PLS-SEM) as appropriate software for predictive research and can sufficiently handle both reflective and formative measurement models (Yildiz, 2023). The choice of confirmatory factor analysis (CFA) is deeply intertwined with the choice of PLS-SEM because of the following: when the statistical objective of the research is predictive, measurement validation and model confirmation, PLS-SEM is the preferred method (Hair, Mathews, et al, 2017; Shmueli et al, 2019). Secondly, PLS-SEM is mostly associated with exploratory and development of theory (Hair, Howard, et al., 2020) and provides more accurate estimates with small sample size (Hair and Sarstedt, 2019). Finally, PLS-SEM easily assess endogeneity and measurement invariance test to address the issues of biased estimates and constructs are measured for valid comparison (Hair, Howard, et al, 2020).

The six scales were assessed using the approach of Anderson and Gerbing and Gerbing and Anderson. Individual construct's unidimensionality, reliability, and validity are estimated by the measurement model (Green et al, 2006). The measurement model described how efficiently the observed indicators measured the latent variables.

CFA method was adopted, another refined method, together with EFA was used to specify the measurement model. Assigning indicators (such as survey items) to a latent construct or variable constitutes determining the measurement model (Garver and Mentzer, 1999). Following the instruction of Cohen and Winn, (2007) distinctive measurement models were estimated for each construct within the STGEES. Once the scales' unidimensionality has been proven, additional validation studies must wait until the statistical reliability has been evaluated (Mohammed Yashik and Mathew, 2023).

The dependability of the indicator and scale were both estimated. The squared factor loadings for an indication are communities or indicator reliability. Every single indicator is measured. According to Nunnally and Bernstein (1994), internal consistency or the degree of intercorrelation among the scale items is how scale dependability is operationalized. It illustrates the scale's capacity to provide the same results throughout time. Scale reliability was evaluated using Cronbach's alpha, construct reliability, and variance-extracted measures. Convergent and discriminant validity were among the various types that were evaluated.

4.2 Pilot Test and Gathering of Data

SMEs were asked to fill the survey instrument and feedbacks were requested from them on the structure, instrument and items in addition to their personal answer. The respondents were allowed to criticize the questionnaire and their inputs were duly noted.

Before the conduct of pilot test, few of the items were rearticulated, improved, or modified to be more symptomatic of the target structure, thereby, enhancing the content validity of the instrument. Final administration was personally collected by the researcher in partnership with Climate Action for Africa. Previous scholars have adopted this methodology, including (Thabane et al, 2010; Hashim, 2012; Mohammed Yashik and Mathew, 2023).

4.3 Unidimensionality: Exploratory Factor Analysis

Exploratory Factor Analysis was adopted to measure the unidimensionality. The degree in which an item on a scale is utilized to estimate a single concept is referred to as unidimensionality. Unidimensionality is a must for validation and reliability to be assumed (Mohammed Yashik and Mathew, 2023). The survey instrument was subjected to EFA to ascertain if all items loaded onto their individual variables. Without putting limitations on

the components number that would be derived, all the elements in the study were subjected to a principal component actor analysis employing VARIMAX rotation. Before subjecting the elements to EFA, the Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's Test of Sphericity were conducted to ascertain the degree in which the data is well-suited for factor asymptomatic. KMO ascertains the strength or weakness of correlation among variables. The survey instrument showed a middling KMO value = 0.756, an indication the data is moderately suitable and appropriate for factor analysis. The Bartlett's Test of Sphericity ascertained if the correlation between variables under investigation are adequately strong for factor analysis. Consequently, to be able to achieve factor analysis, Bartlett's Test of Sphericity is needed to be significant (Malhotra, 2005). From the analysis conducted, it was observed that all scales has p = 0.000 less than 0.05; which means that the variables are correlated and appropriate for factor analysis.

Table 1: KMO and Bartlett's Test of Sphericity

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.756
Bartlett's Test of Sphericity	Approx. Chi-Square	666.203
	df	15
	Sig.	.000

4.4 Confirmatory Factor Analysis

The scales were caused to undergo CFA procedure through the use of consistent PLS-SEM to perform a correction of reflective construct correlations to ensure that the outputs are consistent with a factor model (Dijkstra and Henseler, 2015; Ringle et al, 2024). The first step is to define constructs and their associated indicators to establish measurement model; by specifically showing the relationship between latent constructs and between latent constructs as well as their indicators. The second step is the outer factor loading assessment which is the estimation process used to check the indicator reliability, construct reliability and validity for suggested values fit indices and their description.

Hair et al (2022) opines that reflective indicators and observed variables should be excluded from the measurement model if they have an outer standard loadings value of less than 0.4. The reason is that they do not contribute meaningfully to measuring the construct and may reduce validity and reliability of the model. It means that indicators that is 0.40≤ outer loading <0.70 is acceptable and should be retained if the construct's CR and AVE remain above standard (Hair et al, 2022).

4.5 Reliability Analysis

Assessing reliability criteria, we adopted composite reliability to assess internal consistency of constructs (Hair et al, 2018). Values ≥0.7 indicate high level of reliability (Hair, Hult et al, 2022; Hair, Sarstadt et al, 2024). The rho_a and rho_c ranged from 0.726 to 0.869; are considered "acceptable in exploratory research" "satisfactory to good" (Hair et al, 2022). Another criterion for assessing reliability is Cronbach's alpha; according to tradition, reliability criteria should be ≥0.7 (Hair, Hult et al, 2022; Hair, Sarstedt et al, 2024). It is pertinent to note that all the constructs ranged from 0.727 to 0.854, which indicates no individual construct measures the same concepts, and no signs of redundancy (Hair, Risher et al, 2019; Hair et al, 2020, Hair, Howard et al, 2022).

4.6 Validity Analysis

Validity ensures that the measurement model accurately reflects the construct it aims to measure and includes assessment of convergent and discriminant validity (Kaplan and Sacuzzo, 1993). Convergent validity is obtained by measuring the AVE of the indicator reliabilities of a construct (Hair, Howard et al, 2020). For validity check to be satisfied the estimates should be positive and the criterion measures for AVE value should be ≥0.5 (Hair, Howard et al, 2020). Findings showed that moderate convergent validity existed; meaning that constructs already share a moderate proportion of variance, a positively correlation with each other and established good internal consistency.

Table 2: Construct Reliability and Validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	AVE
GEE	0.728	0.879	0.751	0.530
GIE	0.778	0.836	0.869	0.786
GMAE	0.727	0.761	0.726	0.579
GPFIE	0.851	0.877	0.854	0.599
GCFIE	0.785	0.795	0.786	0.533
ECO_ENT	0.854	0.854	0.852	0.591

4.7 Discriminant Validity

Discriminant validity measures the unique correlation between variables within same construct (monotrait) and distinctive correlation between variables of different constructs (heterotrait) (Henseler et al, 2015; Mohd Dzin and Lay, 2021). When the shared variance in a construct (AVE) is above the shared variance among the constructs, discriminant validity is demonstrated (Hair, Howard et al., 2020). The method used to assess the discriminant validity is HTMT ratio of correlation. HTMT has become the main assessment criteria over cross-loading and the Fornell-Larcker method. The cut-off value should be ≤0.90 (Henseler, Ringle et al, 2015) to demonstrate discriminant validity has been established among reflective measured constructs (Hair, Hult et al, 2022; Henseler, Ringle, Sarstedt et al, 2023). Evidence of discriminant validity has been established; meaning that the individual constructs in this model are truly distinct and not measuring the same underlying concept.

Table 3: Showing Discriminant Validity

Heterotrait-monotrait ratio (HTMT) - Matrix						
	CFIE	ECO_ENT	EE	GIE	MAE	PFIE
CFIE						
ECO_ENT	0.852					
EE	0.537	0.491				
GIE	0.309	0.555	0.243			
MAE	0.682	0.667	0.671	0.386		
PFIE	0.818	0.673	0.537	0.307	0.843	

4.8 Model Fit Assessment

Henseler et al (2014) operationalized the use of SRMR as a goodness of fit measure that should be applied to avoid model misspecification in PLS-SEM. In a more conservative interpretation, a value of SRMR that is ≤0.08 (Hu and Bentler, 1999) or a liberal interpretation of SRMR value ≤0.1 (Henseler et al, 2014) alike were deemed good fit measure.

Table 4: Model Fit Indices

Fit Summary		
	Saturated Model	Estimated Model
SRMR	0.085	0.085
d_ULS	1.371	1.371
d_G	0.870	0.870
Chi-square	1563.852	1563.852
NFI	0.889	0.889

This study's model showed SRMR of 0.085 indicates that the model is considered moderate fit; it is acceptable especially in this early stage. The NFI values ranges from 0 to 1, with values closer to 1 indicating better fit. A commonly accepted threshold for perfect fit is ≥0.90. With an NFI value 0.889 the model is close to, but slightly below the conventional cut-off. This suggests a moderate to acceptable fit, especially when viewed alongside the acceptable SRMR and discrepancy measures. While the model fit is not perfect, it is sufficiently robust to support further analysis, because the theoretical justification of the model structure is strong.

5. Discussion, Conclusion and Recommendation

The assessment of construct validity and reliability, unidimensionality and model fit through PLS-SEM indicate that the constructs developed and scale used in this study is statistically valid and reliable. The approach adopted to measure the six scales, showed that the nature of the scales were not one-dimensional. However, with the help of CFA, scale refinements were carried out to arrive at better scales that were fit. The EFA established that the scales were one-dimensional and have good fit indices. The reliability of the scales were evaluated and established through the construct composite reliability and Cronbach's alpha reliability coefficient to measure reliability which indicated tolerable level of scale dependability. The evidence from the assessment model demonstrated that a moderate convergent validity was established and a fundamental proof of internal consistency.

The researchers focused on validating the STGEES based on six dimensions (EE, GIE, GMAE, GPFIE, GCFIE and ECO_ENT). Findings showed consistency in terms of psychometric features across the different kinds of validation methods used by the researchers. This proof that the measurement scales can be adopted in diverse scales, depending on the context of the study. The validation of these six constructs showed that the items are statistically valid and reliable. The findings provides new additional information of a validated framework for measuring green entrepreneurship in Nigeria SMEs, as these scales are suitable for use in semantic differential scales.

The contributions to knowledge to academics and professionals need were considered. The paper explored current theoretical research whose purpose is to enhance the scope of green entrepreneurship and environmental sustainability research. The development of the STGEES is the major contributions to knowledge of this study. This study contributes to the research discipline by using Nigeria as its sampling country, and with the use of PLS-SEM, for measurement model confirmation and developing or adapting multi-item measures, this study makes a methodological contributions. The findings can be trusted because PLS-SEM can be adopted to enhance individual item and scale reliability, the development, adaptation, and confirmation of measurement scales (Petter, 2018; Hair, Howard et al, 2020). The reliability and validity assurance provides a solid premise for both managerial and theoretical knowledge. This is due to the strict methodology adopted and the good internal validity which would boost practitioners' confidence in the study's conclusion. The final refined and retained items scale developed are below:

Table 5: Retained items in the STGEES

Items	Statements	Outer Loadings
EE_2	I frequently identify ideas that can be converted into new products or services in environmental protection industries.	0.802
EE_3	I frequently identify opportunities to start up new businesses in the environmental protection industries	0.571
EE_4	I enjoy thinking about new ways of doing green businesses	0.471
GIE_7	I expect all the firms in the industry to be environmentally responsible	0.811
GIE_8	Being environmentally responsible is a requirement for firms to be a part of this industry	0.571
GMAE_13	There is a high demand for green production and services.	0.825
GMAE_14	There are wide opportunities for green procurement.	0.488
GMAE_17	Changes occurring in the natural environment redefine the institutional and natural environment of firms and their market	0.720
GPFIE_18	Producer implementation of clean technologies leads to cost savings	0.726
GPFIE_19	Producer renewable choice leads to discovery of new knowledge	0.962

Items	Statements	Outer Loadings
GPFIE_20	Knowledge of renewable choice enhances market for superior environmentally products and services.	0.639
GPFIE_21	Green focused knowledge of imperfect market information presents unknown conditions for potential economic actors	0.731
GCFIE_23	Customer imperfect information can contribute to environmental degradation	0.685
GCFIE_24	Environmental entrepreneurs can capture opportunities by informing customers regarding the environmental attributes of products and services.	0.699
GCFIE_25	Customer imperfect information regarding product or service attributes presents opportunities for entrepreneurial action.	0.838
ECO_ENT_28	I see waste as an opportunity to save valuable resources.	0.795
ECO_ENT_29	I am conscious of environmental components and resources	0.787
ECO_ENT_30	I am conscious of level of pollution and environmental devastation	0.714
ECO_ENT_31	I advance quality of the natural environment in my products and services	0.775

There some limitations of the study that must to be looked into by researchers to shed more light on the state of the research. The objective of this study was to develop a dependable and valid instrument that could be used to measure STGEES. However, this instrument has only been tested among SMEs within the innovation district that operates in South-East, Nigeria. To attain the hallmark of scientific research, this empirical scales need to be adjusted and cross-validated on diverse samples. For future research, it is pertinent to subject these scales to a different study context, to show rigor, reliability, validity, generalizability, confirmation of measurement scale and dependability. Future research can use these scales in semantic differentiation scale on sample study that possesses same characteristics, especially SMEs in manufacturing and agriculture sectors; as this study did not differentiate the influence of sector-specific dynamics on green entrepreneurship and sustainability.

Ethics and AI Declaration

This research did not include sensitive data/information that needs approval from any institutional review board (IRB). The authors affirm that AI tool, which include ChatGPT from OpenAI, were used specifically to edit language and enhance the manuscript clarity of expression.

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Customer-Centric Digital Business Training: Evaluation of Entrepreneurs' Skills and Training Content

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Abstract: In an increasingly digitalised business environment, customer-centricity has become a key factor in ensuring long-term success and competitiveness for micro-enterprises. Understanding the needs of the customer is essential for developing sustainable and valuable digital services, as it enables micro-enterprises to target products and services efficiently. As customer needs and digital services are changing and evolving, the digital skills and competences of micro-enterprises often need to be developed or regularly refreshed." To understand how digital business training can foster a customer-centric approach in entrepreneurs, this paper examines the outcomes of a project providing digital skills training for micro-enterprises in the South Savo region, Finland. This two-year case study evaluates the effectiveness of the digital business training in developing customer understanding. The research questions are: 1) How do micro-entrepreneurs assess their level of customer understanding before and after attending the project's training sessions? 2) How successful has the project been in fostering and supporting customer-centricity and understanding through its training programs? Following a customer-centric approach grounded in the theoretical literature, we surveyed 129 entrepreneurs using a questionnaire on digital business competences. Using metrics, we assessed the entrepreneur's level of customer understanding and the supporting business practices. Further, we analysed the content of 29 different digital business training courses to evaluate how they support, or not, entrepreneurs in improving their focus on the customer and the types of customer-oriented actions in their business operations. The results reveal that project contributed to a visible improvement in entrepreneurs' customer-related competencies. Digital business training courses supported this by using customer-oriented methods and training sessions themselves being described in customer-centric way. More research would be needed on assessing the long-term impact of customer-centric digital business training on micro-enterprises' operational practices, customer engagement, and sustained business growth, particularly in how newly acquired competencies are maintained, adapted to evolving digital environments, and translated into measurable business outcomes over time.

Keywords: Customer-Centric, Customer Understanding, Digital Business Training, Micro-Enterprises, Finland

1. Introduction

In Finnish business culture, a production-oriented mindset still dominates, with services often developed from the organisation's perspective rather than customer needs. Although some companies have successfully adopted customer-oriented approaches, there is a growing need for tools and metrics to support this shift (Saarijärvi et al. 2020). According to the Finnish Government (2022), barriers to digital development in SMEs include a lack of growth ambition, limited vision, insufficient financial resources, and a lack of expertise. Understanding the opportunities enabled by digitalisation that can drive business forward is essential.

Even when solo entrepreneurs are motivated, the development of digital skills, or the adoption of new tools is often limited by a lack of time. In many cases, external encouragement and support are necessary to initiate change. The effectiveness of digital training depends on recognising the diverse users and their varied needs, and on targeting support to these needs, which requires understanding of the users and their operational context. (Digital and Population Data Services Agency, 2021).

Small and medium-sized enterprises in the region mainly operate within traditional industries, with the service sector being the largest employer. The number of growth-oriented companies in the area remains limited (The Regional Council of South Savo, 2022). Due to the region's business profile, this paper focuses on developing customer-centric business operations in small enterprises, and solo entrepreneurs.

The *digital steps - towards customer-oriented digital business* project (2023–2025) aimed to improve small and medium-sized enterprises (SMEs) digital skills and customer-centric thinking in the South Savo Region, Finland. Training sessions, coaching, and focused development programmes helped participating SMEs achieve business growth. The project has reached 180 SMEs, mostly micro-companies, in the region. During the past 18 months, the project has provided 96 digital skills training sessions at both basic and advanced levels. 134 SMEs have participated in the training sessions, coaching and focused development programs built around the needs of SMEs.

The paper presents a case study on how entrepreneurs evaluate their development of customer understanding as a result of the digital business training. Our research questions are: how do micro-entrepreneurs assess their level of customer understanding before and after attending training sessions? And how successful has the project been in fostering and supporting customer-centricity and understanding through its training programs?

The paper proceeds as follows: first, we review previous literature on customer-centric thinking, its benefits for businesses and their customers, and practical methods for implementing this approach. After that, we outline the results of the entrepreneur's level of customer understanding before and after participating in training sessions, coaching and development programmes. Next, we examine the training descriptions conducted by the project and analyse how customer-centricity appears in the training content. We conclude by discussing how the results reveal the digital competence of SMEs from the perspective of customer- centricity and how training programs can better support customer-oriented digital business.

1. Customer-centricity as a Competitive Advantage

Global markets and the technological capability to purchase anything from anywhere have given customers a level of power they did not previously possess (Fader 2020). Customers are no longer limited to products and services offered by local businesses; instead, they can easily acquire what they want, when they want. Small businesses are now expected to deliver customer experiences as seamless as those of large corporations, and customers are quick to switch providers if they perceive the service as too slow or complicated (Hänti, 2021). This shift requires companies to change their perspective and adopt a customer-centric approach. As Giménez (2018) argues, maintaining an ongoing and meaningful relationship with customers is the only way to survive in the competitive market. Furthermore, Adlar et al. (2020) emphasise that every company has its own set of activities that drive customer-led growth, though such change does not happen overnight.

By adopting a customer-centric approach, businesses can build a more sustainable model by focusing on the acquisition and retention of committed customers, nurturing long-term relationships, and increasing purchase frequency or transaction values. This requires shifting the company's focus towards what it knows its customers want (Fader 2020). Such an approach enhances the company's ability to adapt to changing markets, cope with intensified competition, and ultimately achieve higher profitability. Successful companies consistently develop a strong understanding of their customers and establish practices for utilising the customer's point of view. This is based on customer surveys conducted regularly by the company in an effort to avoid unnecessary costs and failures (Vuorela 2024).

Collecting and maintaining essential customer data is an important part of building a deeper understanding of a company's customers. Ahvenainen et al. (2017) state that many companies have access to large amounts of customer data they do not use. This may be due to a lack of knowledge on how to utilise the data, or because existing systems do not offer relevant information. Implementing a Customer Relationship Management (CRM) system is a key step in addressing this; with CRM, businesses can identify their most valuable customers, estimate customer lifetime value (CLV), and create meaningful customer segments. Leveraging this data enables entrepreneurs to personalise their marketing efforts, target the right audience more effectively, and provide superior customer service (Fader 2020). For SMEs, this might be a very straightforward system of keeping records of customers and their purchases, though EU data protection laws, such as GDPR, must be taken into account.

Technologies and data analytics tools also allow companies to understand and anticipate the types of products, prices and channels their customers prefer. Moreover, nurturing customers after the purchase is vital to building customer loyalty (Giménez 2018) and measuring customer satisfaction provides insights into what a company does well and where improvements are needed. Nurturing customers throughout the customer journey requires continuous interaction between companies and their customers, which is why focusing on the design of customer-oriented texts is a concrete way to be customer-centric by improving the experience. Texts that are difficult to understand or are too official or formal can lead to a negative customer experience and may cause the customer to choose a competitor next time (Öörni, 2024).

According to Makkonen & Gracia (2018), you need to choose the right words to communicate your value proposition to your users: What problem are you solving, or what is the main value proposition? Different audiences need different messages and different design styles, underscoring the need for tailored customer communications.

2. Entrepreneurs' Level of Customer Understanding

In order to understand the level of digital skills, we conducted a competence mapping survey at the beginning of the project. The survey included six themes and 18 competence areas. This data was enriched in meetings with a business advisor. The entrepreneur or staff members participated in the training sessions, coaching or eCommerce development program. Some SMEs compiled training and coaching which supported learning and adopting new skills more efficiently. The training approach focused on practical support, emphasising real-world skills and peer-to-peer learning. Participants also had access to online materials like blogs, articles, and guides to help them adopt and apply new tools and knowledge. In addition, companies received personalised coaching based on their specific needs.

After learning new skills, tools and digital business strategies, the SMEs were asked to repeat the same competence mapping survey. The competence mapping was conducted with the Hyviö tool. Hyviö is created to evaluate the impact of services or projects where service providers and customers would benefit from a simple tool that tracks long-term outcomes, rather than focusing solely on short-term results (Janhunen & Kosonen, 2022). This data is important to verify the impact and outcomes of the project as it enables the identification of the desired change within the target group of the activity (Häyrinen & Saali, 2021).

During the period 2023-2025, 180 SMEs participated in the project and met with a business advisor. For over 50% of the companies, this was their first time engaging with the Digital Steps project's training offering or related actions. Altogether 129 companies conducted the digital skills assessment in Hyviö. In this survey, the largest group was the service industry, comprising 26 companies. The second largest sector groups were accommodation and food services (19), and third largest wholesale and retail trade (17). Most respondents were small businesses: solo entrepreneurs and micro-enterprises (1-9 employees) accounted for 117 companies, representing nearly 91% of all respondents. Only seven (7) companies were small enterprises (10–49 employees), and just two were medium-sized enterprises (50–249 employees). Women represented the larger share of respondents (93), while 33 were men. The average age of the respondents was 47 years.

In the Hyviö tool, the level of digital business development can be monitored by retaking the survey. The survey was sent to those entrepreneurs who had participated in the project activities after the initial assessment. Entrepreneurs joined the project at different times, and some only joined during the final months. Therefore, the follow-up survey request was not sent to all companies. It was defined that there must be a 10-month gap between the initial and follow-up surveys. Therefore, the survey was sent to companies that had completed the initial assessment by the end of September 2024 and had participated in project activities thereafter. The follow-up survey was sent on 7 March 2025 to 76 companies. By 14 April, 14 companies had responded to the follow-up survey.

Table 1 presents all the competence areas covered in the digital skills mapping. This article focuses on two key areas: competence and resources, and metrics that support customer understanding and the values are only shown in these areas. The first column contains the value from the initial survey, the next column contains the value from the follow-up survey, and the last column contains the absolute change between the initial and follow-up measurements. In the self-assessment of digital competence mapping conducted in Hyviö, respondents rated the level of their digital business on a scale from 1 to 7. Below 3.0 points: the company still needs support in developing its digital business. 3.1–5.0 points: the company is making good progress in digital business development. Above 5.0 points: the company is already quite advanced in its development.

Table 1: Competence mapping survey. Competence areas and statements.

Multiple Choice Questions **Respond to the following statements on a scale of 1 (strongly disagree) to 7 (strongly agree):**	**Initial survey (avg.)**	**Follow-up (avg.)**	**Change**
A) COMPETENCE AND RESOURCES 1. We update our website/online store regularly. 2. We continuously develop digital products/services. 3. Resources are allocated for the development of our digital services.			
B) METRICS THAT PROMOTE CUSTOMER UNDERSTANDING 4. We regularly collect customer feedback. 5. We improve the customer experience of the website based on user data.		**4,1**	

Multiple Choice Questions **Respond to the following statements on a scale of 1 (strongly disagree) to 7 (strongly agree):**	**Initial survey (avg.)**	**Follow-up (avg.)**	**Change**
6. We perform conversion optimisation, meaning our site is designed to maximise contacts, email list sign-ups, or purchases.	**2,9** **2,8** **2,7**	**4,2** **4,2**	**+1,2** **+1,4** **+1,7**
C) ACTIONS THAT PROMOTE CUSTOMER UNDERSTANDING			
7. We regularly produce customer-centric content online. 8. We offer personalised products, services, and recommendations online for different customer profiles. 9. We serve our customers through multiple channels.	**3,7** **2,7** **2,9**	**4,2** **3,8** **4,1**	**+0,5** **+1,1** **+1,2**
D) PROCESSES 10. We regularly monitor analytics, advertising results, and visitor data. 11. Our company has proper data security and privacy measures in place. 12. We effectively utilise artificial intelligence (AI) in content production or other business operations.			
E) TOOLS 13. Our customers can easily find us online even when they do not know or remember our company name. 14. We regularly do paid advertising on social media. 15. We use email marketing software and regularly send information and offers to subscribers.			
F) DIGITAL STRATEGIES 16. We systematically utilize digital solutions and tools that save time and money and improve efficiency. 17. We grow our business with scalable digital products and services. 18. We regularly sell our products and services outside Finland through digital channels			

The scale in the assessment is 1-7; 1 strongly disagree and 7 strongly agree. Based on the initial competence mapping, the entrepreneurs rated their skills level very low. The average scores for the other statements remained between 2.7 and 2.9. Statement number 7, "We regularly produce customer-centric content online", reached the highest score of 3.7. According to the follow-up survey, the average score for all competencies had increased by +1.1 to +1.7. The smallest increase was in statement number seven (7); however, it initially had the highest initial score of all statements.

When examining the data more closely, it becomes evident that the companies' responses are distributed across both ends of the scale. For all questions, responses ranged from 1 to 7. Among the indicators measuring customer-centricity, 64 companies (51%) rated their competence below 3.0, indicating a need for support in developing customer-oriented digital business actions. A total of 46 respondents (37%) fell within the mid-range of 3.1–5.0. Notably, 15 respondents (12%) rated their customer-centric digital business competence above 5, suggesting that these companies are already quite advanced in this area.

Based on the low number of respondents, the overall results of the follow-up survey cannot be generalised: only 14 out of 76 entrepreneurs responded. However, some conclusions can still be drawn. Overall, the responses suggest that participation in the project's activities has improved the entrepreneurs' customer understanding, and many have taken actions that promote deeper customer insight. The greatest change was seen in statement number six (6), where the respondents evaluated conversion optimisation – in other words, how well the company's website is designed to generate as many contact requests, newsletter sign-ups, or purchases as possible. In addition, statement five (5) "we improve the customer experience of the website based on user data" had increased by 1.4.

3. Analysis of Digital Business Training

This chapter analyses how the digital business training provided within the project supports customer-centricity and customer understanding. It analyses this from two different perspectives: first, how these principles are reflected in the training descriptions, and second, what kind of customer-oriented business practices the trainings aim to promote according to the training descriptions.

1.1 Customer-centricity and Understanding in Training Programs

Based on the selected topics that arose from the survey and competence mapping, suitable professionals are tendered out specifically for these trainings. The tendering process emphasises customer-centricity and practical relevance to ensure entrepreneurs receive as much concrete support as possible for their digital challenges (Rajahonka et al., 2023). Training coordinators create the course descriptions based on the syllabus provided by the selected trainer. Each description is then reviewed and approved by the trainer before being published in the project's training calendar. Once approved, the description forms the basis for communication materials used to promote the training via newsletters and social media channels.

To conduct the analysis, we defined specific criteria for evaluating the customer-centricity of the training descriptions. The selection was guided by core principles of customer-centricity and communication. Piskonen and Syrman (2024) state that customer-centric communication helps customers make informed decisions, provides all the necessary information for decision-making and leaves them with a positive impression of the organisation. The six criteria were (1) target customer, (2) clarity and structure, (3) benefits to the target customer, (4) language and tone, (5) call to action (*CAT), and (6) personal support.

The target customer needs to be clearly defined by the writer and easily identifiable in the text (Piskonen, Syrman, 2024). Aiming for clarity and an easy-to-read structure makes the text more approachable and accessible to readers. Reader-oriented text aims to ensure that essential information is easy to locate and understand in written documents (Öörni 2024). Communicating benefits to the target customer requires knowledge of their needs and understanding how the training can help address them. Clearly stated benefits in the course description support decision-making by helping the customer assess whether the training is relevant and valuable to them.

Language and tone used in the text will convey the writer's attitude towards the reader (Öörni 2024). Functional writing uses familiar words and terminology to the target customer. Overly complex vocabulary and a formal tone may cause the writer to appear distant or even arrogant. The call to action should provide explicit information about what the customer should do next if they are interested, along with relevant deadlines and contact details for further questions. Finally, the descriptions were assessed to determine whether they mention opportunities for individual support during the training.

The training offerings were evaluated using a numerical rating scale, where 1 indicated a poor performance with significant room for improvement; 2 indicated a fair level with several deficiencies; 3 indicated a decent standard; 4 indicated a good level requiring only minor refinements; and 5 indicated an excellent performance with no deficiencies.

Table 2: Digital training descriptions' evaluation

Trainings	Target	Clarity	Benefits	Tone	CAT*	Support
Introduction to Facebook and Instagram advertising	4	4	5	4	5	5
Advanced Facebook and Instagram advertising	5	5	5	3	5	4
Create persuasive social media advertising – Advanced training	4	4	5	5	5	4
A/B Testing – Create winning ads on Meta	5	5	5	5	5	4
Customer acquisition on Instagram – Reach, engage & sell effectively on social media	5	5	5	5	5	4

Trainings	Target	Clarity	Benefits	Tone	CAT*	Support
Turn Reels into revenue – How to create video content that boosts visibility and grows your business on Instagram	5	5	5	5	5	2
Canva clinic – City 1	5	4	5	4	5	5
Canva clinic – City 2	5	5	5	4	5	5
Introduction to Analytics for entrepreneurs – Achieving results through data	4	5	5	5	5	1
Customer insight as the engine of sales	5	3	3	3	5	5
First steps in search engine advertising and Google Ads	5	3	4	4	5	3
Achieving results with Google Ads – Advanced level training	5	4	4	4	5	3
Get Things Done workshop (N.N. 1)	3	4	5	3	5	5
Get Things Done workshop (N.N. 2)	3	5	5	4	5	5
Basics of search engine optimisation	5	5	5	4	5	4
Advanced search engine optimisation training	5	4	5	4	5	5
Get found in search results – Google Business profile workshop	4	5	5	4	5	5
Mobile video shooting and editing – Basic training	4	4	3	4	5	5
Mobile photography –Workshop	5	5	5	4	5	5
Writing for the web – Crafting persuasive messages for online and social media	5	4	5	5	5	5
Accommodation entrepreneurs: Take control of Booking – Workshop	4	5	3	4	5	3
WordPress Roast – Optimize your website	3	4	4	5	5	5
Using ChatGPT in everyday tasks	3	4	4	5	5	2
Leveraging AI in content creation	2	5	4	4	5	2
Turn your expertise into an online course	3	5	5	4	5	1
TikTok for business – Basic level	4	4	5	3	4	1
TikTok for business – Advanced level	5	4	5	4	4	5
Opportunities of social media for businesses	4	4	4	4	5	5
Digital clinic: Optimise your Meta pixel and audiences	3	4	5	5	5	5
Average	**4,20**	**4,34**	**4,58**	**4,17**	**4,93**	**3,89**

The most consistent element across the course descriptions was the call to action. The training coordinators followed a clear and structured pattern for this section, providing clear instructions on what is required to participate, including deadlines and links to register. The benefits of the training were generally well presented. Using bullet points to outline these benefits improved readability and made the descriptions easier to skim. The target group was typically mentioned, although it appeared quite far into the description in some cases, which may have reduced the clarity.

The geographical restriction, that the program is intended only for companies based in the South Savo Region, was not mentioned in any of the descriptions. The titles also showed room for improvement. Most simply stated, what the training was about and whether it was at a basic or advanced level. They lacked compelling details such as benefits for the customer or reasons to participate, which could help capture attention. Many of the descriptions would benefit from simplified language. While most of the descriptions spoke directly to

the reader and employed a friendly tone, there were some inconsistencies.

The most unevenly represented criterion across the descriptions was personalised support. In some cases, personal guidance and tailoring were central features of the training. This was reflected in references to the small group sizes, pre-training questionnaires, and personalised feedback provided during the sessions. However, in other descriptions, such elements were not mentioned at all. The project shows a strong commitment to fostering customer-centricity through the different training provisions, although there remains room for improvement in ensuring consistency.

1.2 Customer-oriented Actions Trainings Promote in Business Operations

Due to the study's scope, the analysis focuses on training descriptions rather than the full content of the training sessions. While training descriptions do not provide a complete picture of the training content or its implementation, they serve as a key communication tool between the project and potential participants. Nevertheless, they offer valuable insight into how customer-oriented actions are promoted in training.

Customer-oriented actions examined in the analysis were (1) customer segmentation, (2) use of customer data, and (3) customer-oriented communication. These criteria were used to assess whether the trainings help entrepreneurs target specific customer groups, understand how to collect, analyse and apply customer data, and communicate clearly, relevantly and engagingly to their customers. Training descriptions were evaluated using a three-level scale: mentioned, partly mentioned and not mentioned.

Table 3: Customer-oriented actions in training descriptions

	Mentioned	Partly Mentioned	Not Mentioned
Customer segmentation	11/29	5/29	13/29
Use of customer data	10/29	1/29	18/29
Customer-oriented communication	17/29	4/29	8/29

The analysis of 29 training descriptions revealed variation in how customer-oriented business practices were represented. Customer segmentation was explicitly mentioned in 11 cases and partly in 5. Customer data was used in 10 descriptions, though it was largely absent in the majority. This raises the question of whether customer data should play a more prominent role in training or even be the focus of dedicated training. Customer-oriented communication was the most consistently addressed theme, clearly mentioned in 17 descriptions and partly in 4. This emphasis reflects the fact that most of the training covers marketing-related subjects, such as paid advertising on Facebook and Instagram, organic growth on Instagram, and search engine visibility.

Some training formats, such as practical clinics, did not reference any of the customer-oriented elements. This is because their purpose is to offer hands-on guidance on narrowly defined tools or skills. Only a few descriptions covered all three criteria.

Helping entrepreneurs take customer-oriented actions in their business operations is essential for enabling growth. However, including all three elements in every training might not be practical. The analysis suggests that in some cases, it could be more effective to provide dedicated training focused specifically on customer segmentation or the use of customer data. This would ensure deeper coverage of each topic. Customer-oriented communication is so closely intertwined with digital marketing that it should be incorporated into almost every training. Deeper customer understanding should be addressed in future projects through different kinds of training, such as online courses or workshops.

4. Conclusions

The follow-up survey results indicate a clear improvement in entrepreneurs' customer-related competencies, particularly in areas related to digital engagement and website optimisation. The results imply that the project has supported entrepreneurs in enhancing their customer understanding and taking concrete steps toward more customer-centric practices. In the competence mapping, 51% of the companies assessed their competence levels as low. This is partly understandable, as the participating companies represent various industries and are experts in their specific fields. However, digital business and customer-centric thinking fall outside their core expertise, making these topics challenging.

Customer-centric communication emerged as a key success factor in training content and how the training sessions were described. Clear, engaging communication supports the entrepreneur's ability to understand the value of the training and make an informed decision to participate. Improving the consistency of training descriptions can enhance inclusivity and accessibility. Furthermore, more informative and benefit-driven headlines, the use of subheadings and a friendly tone help establish trust and increase engagement. While businesses outside the South Savo Region rarely register for these trainings, explicitly mentioning the geographical focus could help manage expectations for new readers.

One area where inconsistencies were noted was in the presence of personalised support. Although some trainings featured individual consultation or feedback, others did not mention personalisation at all. Personalised support and how it is integrated into the training should be considered already at the planning stage. The observed inconsistency in this criterion suggests a need for greater emphasis on how each training responds to the individual needs of participants. One trainer offered participants personal consultation after the training as an additional service, which could be considered for future training sessions as well. Naturally, this would increase the trainer's requested fee.

While analysing the competence mapping data, we observed that certain topics had received relatively little attention. At the beginning of the project, we offered a three-part in-person training programme focused on customer-oriented digital business and customer-centricity. Although the training programme was only delivered once due to cost and limited demand, the themes of identifying needs, creating content accordingly, and utilising customer data, remain highly relevant. These should be broken down into smaller workshops or as an online course that each client participating in the project could complete at their own pace. Future training sessions could address for example the following customer-centric themes: 1) defining the company's target groups, 2) utilizing existing customer data, 3) A/B testing the effectiveness of different messages for the same target group, 4) learning how to engage customers on social media, and 5) increasing user-generated content (UGC) on websites or online stores.

These findings not only confirm the positive impact of the training on entrepreneurs' customer-related competencies but also highlight the need for targeted and workshop formats to address specific themes such as data use and customer feedback. The analysis also suggests that training content and its communication should not only reflect customer-centricity but also actively model it throughout the training experience.

Ethics Declaration

Ethical clearance was not required for the research.

AI Declaration

Artificial intelligence (ChatGPT) was used to support the writing and editing of this article. The tool was used to refine language, assist with translation, and enhance overall readability. All content was critically reviewed and approved by the authors.

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The Courage to Cross Over: A Case Study of Identity Evolution in Academic Entrepreneurship

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Abstract: This study examines unexpected events and critical incidents that shape identity development in an academic entrepreneur. Using an intensive case study approach, we analyse how these critical incidents influence identity reconstruction, entrepreneurial motivation, and the shift from academic to entrepreneurial contexts. We also study the role of experienced colleagues in fostering the courage to take the first entrepreneurial step. The research data consists of in-depth interviews with the entrepreneur and observations made over six years on their career development. Their company has since secured significant seed funding and a partnership with a global investor. Additional data sources include press releases and media reports, investor pitching materials, and company records from the Orbis database. The data is analysed through a Critical sensemaking (Helms Mills, Thurlow & Mills, 2010) framework, highlighting identity construction in the social context, where interactions and events shape decision-making. Individual passion and will, environmental factors, and the social dynamics of existing networks characterise personal development from academic researcher to entrepreneur. While the outcome was a successful business, alternative paths remained equally viable. In the early stages, high hopes and unrealistic expectations often drive decisions. However, after establishing a formal company, the entrepreneur faces increased responsibilities, such as ensuring employee salaries and satisfying shareholders. According to our research, only at this stage does the academic identity undergo a true transformation. European innovation policies and university strategies encourage researchers to commercialise their research-based inventions. Although forms of support have been developed for starting a company, external support is often lacking for researchers' support and growth. This study highlights critical stages where forms of support should be developed to meet society's expectations. The path from researcher to entrepreneur is not linear but characterised by interactions of internal and external factors. This study contributes to the literature on entrepreneurial identity by demonstrating through a critical sensemaking approach how social contexts influence the evolution of academic entrepreneurs. Research shows that different forms of support are needed for the researcher-entrepreneur path to meet societal expectations.

Keywords: Academic Entrepreneurship, Identity Reconstruction, Intensive Case Study, Critical Sensemaking.

1. Background

Science commercialisation refers to the systemic translation of academic research results and scientific knowledge into tangible innovations that contribute to economic growth and societal benefit (Palo-oja, 2025). Researchers have been encouraged to seek commercial opportunities for their findings in various ways. For this shift, universities have founded different kinds of supporting activities such as technology transfer offices and incubators and accelerators (e.g. Brandtnell & Baraldi, 2022; Masucci et al., 2024). For research groups and individual researchers, commercial expectations have been realised in terms of increasing industry collaboration, new career options, and personal risk taking (Wang et al., 2022; Clarysse,, Tartari & Salter, 2011). Also, those who have not been interested in business activities have been forced to react for this third mission of the universities and apply a role as a kind of academic entrepreneurs (Neves & Brito, 2020) who apply funding for their continuous flow of research projects, convince variety of stakeholders with the importance and value of their research, and adjust academic interests to societal requests.

Academic entrepreneurship and academic entrepreneurs, as the business-oriented researchers are called (Nyeko & Sing, 2015), have recently become an increasingly studied phenomenon. Academic entrepreneurship has been seen as a process that does not conform to linear commercialisation trajectories (Mäkinen & Esko, 2023; Giunti & Duberley, 2023; Johannisson, 2023). This shift in identity, ethics, and expectations (Moilanen, 2022) radically shapes how academics approach their work through a new commercially-oriented entrepreneurial identity (Hayter, Fischer, Rasmussen, 2021). These shifts are seldom linear or clear-cut; they are most often instigated by key events in someone's life—disruption or catalytic experiences that inspire individuals to reconsider their academic identities and venture into the entrepreneurial realm (Moilanen, Montonen & Eriksson, 2021; Montonen, Eriksson & Aromaa, 2021).

This recognition that academic entrepreneurship cannot be viewed as the product of an abstract, structuralist, or policy-driven environment alone resonates strongly with scholars such as Moilanen, Montonen, and Eriksson (2021) and Johannisson (2023), who emphasise its socially constructed, negotiated, and embedded nature. The

literature on academic entrepreneurship also highlights the embodied and contextual nature of these identity shifts (Bousfiha, 2020). However, becoming an academic entrepreneur does not usually happen by chance. However, it is a cognitive (Mäkinen & Esko, 2023) and intentional process driven by several individual, organisational, and institutional factors (Neves & Brito, 2020).

Still, academics occupying entrepreneurial roles face identity tensions and role conflicts as they negotiate conventional academic norms such as scholarly autonomy, peer recognition, and disciplinary rigour with the imperatives of market-oriented innovation (Giunti & Duberley, 2023). For many, entrepreneurship is not a natural continuation of their academic work but a distinction requiring much reflection and adaptation.

The recent literature shows how these tensions play out across hybrid roles that bridge academic and entrepreneurial spaces (Montonen, 2025). Some individuals find a way to integrate these identities, while others experience them as disjointed or conflicting (Giunti & Duberley, 2023; Majoor-Kozlinska, Hytti & Stenholm, 2024).

Liminality has proven helpful in describing the in-between spaces that academic entrepreneurs find themselves in—spaces of ambiguity but also possibility (Hayter, Fischer & Rasmussen, 2021; Montonen, Eriksson & Aromaa, 2021). In these liminal moments, identity reconstruction is responsive but also strategic and agentic, shaped by sensemaking processes (see Weick, 1995) and contextual contingencies (Mäkinen & Esko, 2023).

The social dimension is also crucial to the identity transformation process. The role of involved colleagues, mentors, and peer networks cannot be overstated. Informal learning and social support are often more powerful than formal mechanisms such as technology transfer offices (Yetisen, 2021; Gubbins, Harrington & Hines, 2020; Palo-oja, 2023). Observing colleagues who successfully transition into entrepreneurial roles creates vicarious learning opportunities and helps legitimise entrepreneurship as a viable academic path (Shi, Zou & Santos, 2021; Johannisson, 2023). These forms of social support enhance entrepreneurial self-efficacy and encourage academics to pursue new professional directions.

Academic entrepreneurship is a dynamic and situated process characterised by disruption, reflection, and transformation. It is shaped by the interplay of structural forces, personal agency, institutional contexts, and social relationships (Li et al, 2020; Nielsen & Lassen, 2011). This article contributes to the emerging discourse by offering an in-depth exploration of the lived experience of an academic entrepreneur. It focuses on how critical incidents and collegial support catalyse identity reconstruction and entrepreneurial motivation. Viewed through this lens, academic entrepreneurship emerges not as a linear path but as an emergent, reflexive practice grounded in experience, dialogue, and evolving professional landscapes.

2. Research Design

The study is based on rich and versatile data collected over six years. Central to data collection were repeated, in-depth qualitative interviews with the academic entrepreneur, which provided rich descriptions of the entrepreneur’s personal experiences, thoughts, and developing identity as they transitioned from an academic to an entrepreneurial orientation. For anonymity reasons, the academic entrepreneur's name, field of study, or company is not disclosed, but he or she is referred to with the neutral pronoun they.

The interviews have been complemented by prolonged observational fieldwork, documenting their career trajectory and the broader context in which their entrepreneurial process developed. Throughout the study, the entrepreneur's startup reached some important milestones that constitute decisive points for review. Perhaps most notably, the company was able to obtain considerable seed money, which is why the company is characterised as a successful university spinoff company in this study. This investment was complemented by the establishment of an important strategic association with an internationally known investor, further raising the profile of the company and broadening the possibilities for operations.

Additional data sources were included to enrich the analysis and to triangulate findings. These additional data include publicly accessible media reports and press releases, contextualizing the company’s public discourse and external market positioning. Investor pitch documents gave a direct view of the company’s value proposition and maturity path. At the same time, records collected from the Orbis database presented formalised financial and organisational data to bring in a richer background to understand the company’s development.

The analytical process is loosely based on the Critical Sensemaking frame (CSM, Helms Mills, Thurlow & Mills, 2010). The CSM approach offers a nuanced view of how individuals interpret their organisational experiences by integrating agency, discourse, and structure. Building on and critiquing Karl Weick’s (1995) original sensemaking

theory, CSM addresses its limitations by incorporating perspectives from Foucault (1979) on discourse and institutional theory on structural constraints (Mills & Murgatroyd, 1991). Unlike Weick's focus on individual cognition, CSM foregrounds the role of power and formative (Unger, 1978) or institutional (Mills et al, 2023) contexts in shaping what individuals perceive as plausible or legitimate. It highlights how people navigate and negotiate meaning within historically and discursively shaped environments.

Based on the CSM framework, critical incidents were identified from the interview data. We specifically searched for cues about phases when the researcher made a conscious or unconscious choice, or recognised and seized the opportunity they had identified. This way, we identified four critical incidents through which the researcher had the courage to cross over the invisible line between academia and business. These four incidents or steps were analysed thoroughly based on all data sources we had.

3. Findings

The critical events in the path from a student and academic researcher into an academic entrepreneur were summarised into four steps: Coincidence leads to an interesting career; funding gaps threaten the academic future; research focus shifts; and Lessons for business life from the academic world. Next, these phases are described in more detail and coloured with verbatim data extracts.

3.1 Coincidence Leads to an Interesting Career

The secondary school graduate in their twenties planned to study a field that involved close contact with people but was not ready to commit to the demanding entrance exam process. So, they decided to study something else instead and only applied to their favourite field a year later. However, the second choice of study, which was more technical, hooked the graduate student due to its proximity to real-world applications. Surprisingly, the most inspirational applications were attached to their first choice of studies.

The summer job at a local technology company determined the final commitment. This job emphasised the student's passion for a specific field and was a start for constructing a personal network within the business. After this summer job, they chose a specialisation and later the topic for their dissertation that was closely connected to solving practical societal problems.

3.2 Funding Gaps Threaten Academic Future

The summer job and the specialisation choice enabled joining the particular research group that was first lucky to receive significant research funding but later suffered from funding loss. This critical event forced the researcher to consider a career pivot and to enrol in professional training in a third field as a backup.

But (I) was still left with a burning desire that I did not want to leave this unfinished, the research I had done. Then, the leader of our research group suggested that we apply for business funding for this kind of research. (Interview 2024)

However, the desire to create social good through research inspired the researcher to consider other options. At the same time, their senior colleague proposed turning research into a product or service via national innovation funding. This was the first step towards the more commercial direction, which, however, faced some delays in positive funding decisions. Commercial interests attracted new members with business backgrounds to the team (Interview 2018, public presentation 2022), encouraging the researcher to see the commercial value of their research. Despite financial issues, the idea of a commercial career remained alive until the research group was more ready for it.

At first, the researcher did not dare to promote the idea commercially. With the colleagues' encouragement and funding for research commercialisation, they finally attempted to found a company (Interview 2018, observations 2018).

A colleague said, "Are you going to ruin your academic career by going down a path where you might fail?" Nevertheless, let's say more people encouraged you than those of that opinion. (Interview 2024)

The new entrepreneur participated in several business accelerator programs with their team (Field notes, video material 2018-2019). Business accelerators have helped them become more mature and knowledgeable about the commercial expectations in the field. They learned business principles, networked with their peers, and developed the idea further.

Although the IP process was complex and required significant resources and revisions, they finally protected their idea (patent register, granted 2024). At the same time, they had to agree on ownership with the university.

3.3 Research Focus Shifts

According to the entrepreneur, forming a foundation team for the new company was the most challenging part (interview 2018). Potential investors expected full commitment to the company, which made only those who could do so transition from academia to entrepreneurship.

When a group from a university leaves to run a company full-time, it is not necessarily the same research group that leaves. However, some people left and reorganised entirely. (Interview 2024)

At first, there was only one full-time employee, but after a year, five, and after two years, 13 people worked for the company (public company registers 2025). The same trend has continued ever since, but the latest statistics are missing from official sources. Only at the time of foundation did the entrepreneur gradually give up their academic career. At first, they worked half and half in the university and company, but after four years, the entrepreneur focused only on their business. (Interview 2024)

They maintained their academic ties but reduced direct involvement to daily practices and steady income streams. One could say they adopted a hybrid role as academic mentor for PhD candidates and founder of a university spinoff.

The research does not end when you enter the market, but the research is continued, as if organised by the company. Scientific research data needs to be generated all the time, and in a way, you need to find those investors who understand what it means in a company with such a scientific background. (Interview 2024)

As a spinoff entrepreneur, they are still involved in research. Thus, research stays focused, although personal dedication is now focused on the business. The only thing that changed with the entrepreneurial intentions was the pressure from the university.

The university hopes for startups and that they will redeem their IPR rights and leave. I don't know how many will quit under pressure from the university, so they will slam their gloves on the counter and not become entrepreneurs at all if it has to be done so quickly. I think they should be given time. (Interview 2024)

What attracted the entrepreneur first to their second choice of study still inspires them in the field, but this time, they are more focused on the commercial aspect. Those are real-life applications that help people. The entrepreneur calls this societal value that their company provides gives them purpose and sustains energy to overcome setbacks. This way, the failure in the initial career plan led to a successful career and work in close contact with people, as they had planned.

3.4 Lessons for Business Life From the Academic World

Personal development has continued since the company's foundation about five years ago. However, the work experience as an academic researcher has prepared the entrepreneur for some difficulties, such as funding issues. The first seed funding round took a long time, and there have been several breaks between funding rounds after that, too.

Of course, a researcher also sees these breaks on the university side, so I wasn't that scared of them. But of course, there are such challenges that it doesn't feel good that (…) negotiations are underway regarding the next investment round, but it may mean that you won't get a raise for x months before the money is in the account again. (Interview 2024)

Previous work in academia also allowed for more flexibility in scheduling tasks. However, in business life, entrepreneurs must balance ambitious future expectations and promises they make to investors with their scarce resources and some delays that often happen, especially in high technology.

Maybe it's been pretty optimistic with hopes of staying on a specific schedule and [promises] when the product will be on the market, when the first customers will pay for it, and other things, that they've been taught it takes time. Resources are not unlimited, and time has to be prioritised. Things will get organised, but they may be delayed a bit; it is, of course, such a challenge. (Interview 2024)

Still, the entrepreneur is enthusiastic about their innovation, which attracted the global funder to invest in the company and create a partnership (press release 2022). The recent good news, parallel to the last tests with customers, helps the entrepreneur justify their dedication, time, and effort.

I don't care about financial things. Those are completely secondary things to me. I certainly wouldn't do the amount of work I do today for money, but I've seen the product in practice and how it benefits people. That gives me the motivation to continue. Also, of course, this team around me that comes together every day and works towards our common goal. It is really important. (Interview 2024)

4. Discussion

Disruptive moments like the postponed application to a dream discipline or failure to get appropriate research funding question the plans and open new possibilities. In a way, these events serve as formative experiences that stem from obstacles, unforeseen advancements in career, or institutional pressures, often becoming defining moments of reconstructing an identity. Critical events may amplify tensions between academic and entrepreneurial careers, but on the other hand, they may also help choose one over the other, which may turn out to be a positive action in the end.

In our case study, the entrepreneur did not exactly feel tension between academia and industry. They only indicated changing priorities in different career steps. First, they were interested in practical solutions but approached them as researchers. After some drawbacks in research funding and a gentle push from their mentor, the focus moved more towards the commercial side. Now, participating in academic work serves more as a hobby or a welcome change from demanding business activities, which is still coloured by science.

The liminal space (Hayter, Fischer & Rasmussen, 2021) between the academic and commercial world may provide the academic entrepreneur more positive feelings and opportunities than tensions or identity crises that some of the literature (e.g., Giunti & Duberley, 2023) has suggested. In our case, the tension was mainly created by external factors such as technology transfer office expectations or investors' expectations for commitment. Both tried to speed up the process of departing from the university and committing fully to the company. However, the social support by peers, new business-oriented colleagues, and senior faculty members, in parallel to lessons learned from academia, helped the entrepreneur to cope with the pressure as expected by Yetisen (2021) and Gubbins, Harrington, and Hines (2020). They formed a solid social equity for the entrepreneur on which they could rely when facing drawbacks.

A confident attitude towards the future, even in the face of financial difficulties, may also be due to the entrepreneur's own personality, which was not studied here. However, it says something about their character that the business was not founded for profit. In our case, the motivation stemmed from personal interest in helping people, not getting financial rewards. This aligns with Yetisen's (2024) study among faculty members, who, however, were not encouraged to depart from academia for entrepreneurial activities.

Factors such as disciplinary background, institutional culture, and regional entrepreneurial ecosystems influence whether hybridity is perceived as harmonious or conflictual (e.g., Majoor-Kozlinska, Hytti & Stenholm, 2024). In our case, the entrepreneur valued the societal benefits and real-life applications their research enabled in academia and business. The entrepreneur had started to network with local companies early in their career, so they were attached to the regional entrepreneurial ecosystem even before spinning out of academia. That way, the entrepreneur matured into a harmonious identity of an academic entrepreneur without any radical tensions or personal crises.

5. Conclusions

This study examined the critical incidents over an academic entrepreneur's career path through a rigorous case study. We discussed how certain planned and unexpected events led to a successful academic spinoff, measured by the number of personnel and capital raised. The case illustrates that the tension between academic and business identities, often described as negative or critical in the previous literature, does not necessarily require specific actions of bridging or selection. An entrepreneurial identity can simultaneously work harmoniously with a researcher's identity, drawing motivation, strength, and learning from both worlds. In the future, it is worth exploring further how we could better support academic entrepreneurs to draw on their previous experiences and combine the best of both worlds. Such research could be approached from the perspective of formative experiences, complementing Unger's (1987) formative context, which is an essential part of critical sensemaking (e.g., Helms Mills, Thurlow & Mills, 2010) literature.

Although the findings are based on a single case study, they highlight the need for organisational support for individual researchers seeking to commercialise their research. For researchers, it may feel natural to start a business while maintaining their academic positions. The pressure to demonstrate societal impact through spinoff companies may matter less for individual researchers than to universities, which can sometimes push academics too hard toward starting businesses and leave their academic positions.

Nevertheless, university spinoffs typically require a strong research orientation, and for their founders, this research is naturally rooted in their university affiliation. Therefore, academic entrepreneurs would benefit from more flexible mechanisms that enable the gradual transition from academia to the business sector, along with the possibility to utilise their home affiliation's infrastructure, expertise, and networks during this transitional phase.

In the long run, this kind of flexibility would benefit both the university and the academic entrepreneurs, promoting mutual knowledge transfer.

Ethics Declaration

Ethical approval was not required for this study, as it did not involve sensitive personal data or vulnerable populations. All interview participants gave informed consent prior to participation, and documentary material was obtained from publicly available sources.

AI Declaration

Artificial intelligence tool Grammarly was used to assist in language editing and to help format references according to the required style. All intellectual contributions, interpretations, and critical analyses are the sole work of the author. The use of AI tools did not influence the research design, data collection, analysis, or conclusions.

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Paradoxes and Creativity in Organizations: A Theoretical Exploration

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Abstract: Following the expansion of innovation as a research topic, scholars have discussed or proposed new approaches and theories. Within the field of public sector innovation, the hypothesis about the positive impact of collaboration (or co-creation) on public sector innovation has been studied or advocated. Within the field of diversity management, the positive influence of different types of diversity on innovation is explored. Within the field of organizational paradox studies, several have argued for a positive link between adopting paradoxical frames and generating creative or innovative solutions (Smith and Tushman, 2005; Miron-Spektor, Gino and Argote, 2011; Lewis and Smith, 2022). Although all three examples could be topics of theoretical exploration, the focus of this paper will be on the third example. While several refer to the idea of working with paradoxes (paradoxical frames) and Albert Rothenberg's idea of janusian thinking as a central reference, few studies have focused on this idea *per se* and its cross-disciplinary travel and use in organization and management studies. Motivated by this observation, this paper asks: What are the empirical and theoretical arguments behind the theoretical idea—and how is it relevant to contemporary organizations? To answer this question, this paper focuses on the sources, development, diffusion, use, and relevance of the idea of paradoxical frames. The theoretical discussion is based on a selection of publications in two areas: (i) publications that cover the spread of theoretical ideas of paradoxical thinking and (ii) literature from the field of organizational paradox studies that discuss the idea. The discussion could be of interest to those interested in creativity and/or organizational paradoxes.

Keywords: Organizational Paradoxes, Novelty, Creativity, Innovation, Paradoxical Frames, Janusian Thinking, Janusian Institutions

1. Introduction

The expansion of innovation as a research topic has generated explorations of new theories and hypotheses about what fosters creativity and innovation, for example co-creation (Ansell, Sørensen and Torfing, 2024), different types of diversity (Østergaard, Timmermans and Kristinsson, 2011) and adopting paradoxical frames (mental templates). This paper explores the third example. A paradox is persistent contradictions between interdependent elements (Lewis and Smith, 2022), where such contradictions are also called opposites, competing demands, tensions, and opposing forces. Tensions and paradoxes are double-edged swords. They may lead to paralysis (Watzlawick, Bavelas and Jackson, 1967) but also novel and creative ideas (Rothenberg, 1971, 1979a; Cameron, 1985; Smith and Tushman, 2005). The latter idea has been taken up by several scholars who share the assumption that tensions and paradoxes are not obstacles but opportunities (occasions) for creativity and innovation (Lewis and Smith, 2014; 2022; Smith and Tushman, 2005; Smith, 2014): "Extent paradox theory suggests that adopting paradoxical frames (…) result in superior firm performance" (Calic et al., 2019, p. 347), that is, about an actor's cognitive juxtaposition and active embracing of competing forces, tensions or contradictions (Smith and Tushman, 2005). Hence, in the literature, there are expressions such as "embracing inconsistent contradictions simultaneously" (Smith and Tushman, 2005, p. 529), and "individuals with higher paradox mindset are more creative" (Miron-Spektor et al., 2018, p. 33). Adopting a paradoxical frame means embracing opposite poles instead of choosing between them (as either-or decision): "Doing so invites us into both/and thinking, embracing tensions to enable more creative, effective, and sustainable solutions" (Lewis and Smith, 2023, p. 16). When this idea is discussed, it is often referred to Rothenberg's (1979a) research on creative individuals and his concept of janusian thinking: "the capacity to conceive and utilize two or more contradictory ideas, concepts, or images simultaneously" (1971, p. 195).

Though the connection to janusian thinking is referenced by several, few have studied the travel of this idea into organization and management research. Motivated by these observations, this paper asks: What are the empirical and theoretical arguments behind the theoretical idea—and how is it relevant to contemporary organizations?

The purpose of the paper is not to advocate a specific theoretical idea but to analyze the theoretical idea itself, its travel into organization and management studies. Further, the relevance in contemporary organizations is discussed through five examples in relation to a simple analytical framework of three keywords: theoretical source, main findings and limitations (see section 4). The idea goes under different labels, such as paradoxical thinking, paradoxical frames, and janusian thinking. The latter term is an idea from individual problem solving

(Rothenberg, 1979a) that has been adopted in organizational contexts and called paradoxical frames – or used as theoretical argument for paradoxical frames. Thus, this paper contributes to studies that conclude that new theories come from borrowing from the outside of the discipline or research field (Oswick, Fleming and Hanlon, 2011). This paper will use the term paradoxical frames when it is discussed in relation to organizations. The idea can be seen as a thought mechanism (Rothenberg, 1979a), a problem-solving idea that involves working with opposites.

Methodologically, the paper is based on a selection of 30–40 publications in two areas: (i) 15 publications that cover the spread of the theoretical idea of paradoxical frames, and (ii) literature (25 publications) from the field of organizational paradox studies that discuss the idea. In both areas, the selection is made from a larger body of literature. The search and selection process in the first area involved tracing ideas and checking other literature and sources. Examples noted in such other literature are Eastern thinking, such as Lao Tsu in the 6th century BC on the integration of opposites (Krippendorff, 1982/2009, p. 297), Polanyi's juxtaposition of tacit and explicit knowledge (Calic et al., 2019). In addition, several deal with embracing opposites (Collins and Porras, 1994; Osono, Shimizu and Takeushi, 2008; Martin, 2009) without explicitly building on Rothenberg. Finally, some of Mary Parker Follett's ideas in the 1920s on "the value of embracing conflict, diversity and opposites" are referred to (Lewis and Smith, 2022, p. 542; see also Smith and Tushman, 2005; Smith and Lewis, 2022; Smith and Lewis, 2011). However, the important information came from Rothenberg's large scholarly production on janusian thinking between 1969–2024 and early organizational paradox literature from the 1980s (e.g., Cameron, 1984).

The search process in the second area was in organizational paradox literature, especially the part of paradox literature that advocates *both-and* thinking/approaches and builds on Rothenberg. The main criterion was to find literature that fits the purpose of the paper, for example the use of the theoretical idea of paradoxical frames as well as examples of use in relation to organizations (see Section 4).

The author is aware of possible limitations of concentrating on one route into organizational research and only building on part of a large body of organizational paradox literature. The author is also aware that this literature represents only one of several perspectives on creativity (Simonton, 2004; Harvey and Berry, 2023). That creativity is often defined in terms of novelty and usefulness (Harvey and Berry, 2023) or that "creativity is novelty that is subsequently judged successful" (March, 2010, p. 75).

This paper is organized as follows: Section 2 gives a brief history of the travel of the idea into organization and management research, followed by Section 3 on contemporary use. The last main section 4 discusses the idea in relation to organizational contexts using five examples of how the idea might be relevant to contemporary organizations. Section 5 concludes and suggests future discussions and studies.

2. The Sources and Travel of the Theoretical Idea in Brief

As noted in the previous section, the idea or similar ideas can be found in different organizational literature and under different labels. However, one important source is Rothenberg's work on creative individuals. Rothenberg (1969, 1971) mentions several sources of partial inspiration when he formulated the idea of oppositional thinking in 1969. However, the main source was his discovery of Eugene O'Neill's revision of the stage play *The Iceman Cometh* from 1939. More precisely, he first described or discovered this thought mechanism in connection with an intensive study of the revision process of this stage play (1969, 1971), five prepublication drafts on *The Iceman Cometh* at the Beinecke Rare Book Library at Yale University and stage set drawings and outline notes in O'Neill's own hand. Rothenberg argued, "It is extremely likely that O'Neill was aware of the similarities and some of the opposing notions when he decided to use the iceman idea" (1969, p. 582). Rothenberg (1969) first discusses the creation of the play, its title and metaphor in terms of oppositional thinking. For example, that O'Neill's central idea in the play, which led him to the creation of the iceman symbol, was, "by means of *simultaneous* conceptualization of opposites" (Rothenberg, 1971, p. 197). Although O'Neill was one primary source, Rothenberg also noted that the idea was not totally new:

> Many of the great conceptions in the history of man consists of dualisms which are actually opposites: (…) They are products of an early phase of creative thought only in the total context of the religion or theory which has been worked out around them (p. 581).

In 1971, Rothenberg reformulated the concept of oppositional thinking to janusian thinking (1971, p. 197). He now defines ideas as "the capacity to conceive and utilize two or more opposite or contradictory ideas, concepts, or images simultaneously" (1971, p. 195) or later as "actively conceiving two or more opposites or antitheses

simultaneously" (1979a, p. 55; 1983a, p. 938). He adds, "Opposites or antitheses are conceived as existing side by side or as equally operative and equally true" (1979a, p. 55). Recently, he noted that this process is "most commonly operative in the early or inspiration phase of creative production" (Rothenberg, 2024, p. 34).

Between 1969 and today (e.g., Rothenberg, 2024), he publishes much on the idea, uses it in studies, using different methods such as interviews, controlled experiments (1983a), "research psychiatric interviews" with highly creative individuals in different disciplines (1979a), interviews with prize-winning authors (Rothenberg, 2014), word association tests on nine Nobel Prize laureates (Rothenberg, 1982), documents, and research accounts (1995). He also studied creative thinking in science by focusing on Albert Einstein (1979b, 1987), Niels Bohr (1983b, 1987), and August Kekulé (Rothenberg, 1995). In several publications over the years, Rothenberg also tried to explain how the theoretical idea was different from other theoretical ideas, such as dialectical thinking, unconscious interchangeability of opposites, bisociation, and associational processes (e.g., Rothenberg, 1996).

In the early 1980s, the idea was adopted in organization and management studies by scholars interested in organizational paradoxes (e.g., Cameron, 1984, 1985, 1986), though others were also partly into similar ideas (Van de Ven 1983). Cameron was later one of the editors of 'Paradox and Transformation,' where others articulated the idea and referred to Rothenberg (Cameron and Quinn, 1988, pp. 4, 13; Bartunek, 1988, 141, 143, 147) or the idea via Cameron (Eisenhardt and Westcott, 1988, p. 191), for example. Eisenhardt and Westcott (1988) agreed that paradoxes have the "power to generate creative insights and change" (Eisenhardt and Westcott, 1988, p. 170). This was later followed by several studies (Lewis, 2000; Smith and Tushman, 2005), which will be discussed in the next section.

3. The Idea in Contemporary Research and Literature: Two Examples

Organizational paradox research is diverse and has several debates. Most paradox approaches are *both-and* approaches rather than *either-or* (dilemmas) approaches. Within this main approach, several see tension and paradoxes as opportunities for generating novel and creative ideas. Hence, these scholars have worked with concepts such as accommodating competing demands simultaneously, embracing paradox, frames, or paradoxical tensions (Lewis, 2000), paradoxical frames and paradoxical thinking (Smith and Tushman, 2005), paradoxical mindset, navigating paradox (Lewis and Smith, 2022; Smith and Lewis, 2022), paradoxical mindset (Miron-Spektor et al., 2018), paradoxical frames (Smith and Tushman, 2005; Miron-Spektor, Gino and Argote, 2011; Miron-Spektor et al., 2022), collective paradoxical frames (Miron-Spektor and Paletz, 2017), and paradoxical leadership (Smith and Lewis, 2012).

Furthermore, these authors refer to Rothenberg in several publications. Smith and Lewis were explicit early on this connection (Lewis, 2000, p. 764; Smith and Tushman, 2005, p. 529). Together or alone, they are involved in a high number of publications; many of their most important studies and theoretical discussions refer to Rothenberg as their inspirational source (Lewis, 2000; Smith and Lewis, 2011, 2012, 2022; Lewis and Smith, 2022, 2023; Smith, 2014; Andriopoulos and Lewis, 2010). Indirectly to Rothenberg through the examples of Bohr and Einstein (Smith, Lewis and Tushman, 2016, p. 69). The positive effects of reframing the relationship between polarized elements (Bartunek, 1988; Smith and Lewis, 2011) in the latest book are seen as "opportunities for learning, growth, creativity" (Smith and Lewis, 2022, p. 27).

Another example is Ella Miron-Spektor, who has authored several publications, and different constellations of authors, referred to three Rothenberg publications, sometimes both 1971 and 1979a (Miron-Spector et al., 2018; Miron-Spektor and Paletz, 2020; Miron-Spector, Emich, Argote and Smith, 2022; Sparr, Miron-Spektor, Lewis and Smith, 2022). In these, there is a belief in the positive relation between embracing and creativity-enhancing effects or positive outcomes (Miron-Spektor et al., 2018). For example, in an early laboratory study of the effect of paradox on creative performance, they said that in their four studies "using different manipulations for activating paradoxical frames and different creativity tasks" (Miron-Spektor et al., 2011, p. 238), they "demonstrated the positive effect of paradoxical frames on creativity" (p. 238). The data material has been reanalyzed by others (Calic et al., 2019).

In summary, the examples illustrate that the idea is adopted into parts of contemporary paradox research. Paradoxical frames are connected to different types of positive effects. When it is discussed in relation to creativity, it is referred to as Rothenberg. These authors are especially interested in *both-and* approaches, not *either-or* approaches (e.g., dilemmas). They argued for exploring tensions, contrasting and integrating opposing elements using paradoxical frames, and that leaders should encourage paradoxical thinking. However, the idea is not clarified and made explicit as a theory or hypothesis, as also noted by others: "The creativity mechanism

of paradox theory is limited by a few propositions and a rough underlying theoretical logic" (Calic et al., 2019, p. 347). The next section briefly discusses some examples (important publications).

4. Discussion: Relevance for Contemporary Organizations

Rothenberg discussed the idea of janusian thinking in relation to the creative process in art, literature, architecture, music, science, and mathematics, not organizations. This section discusses the idea in an organizational context, which differs from Rothenberg's studies of individual problem solving. Table 1 illustrates the different contexts, whereas some are related to organizations.

Table 1: The Context of Creativity: Organizations, Individuals, or Groups

Context	Examples
Individuals (groups) outside organizations	Artists, writers, Picasso, O'Neill
Autonomous Individuals in organizations	Scientists, engineers, Einstein, Bohr (in institutes)
Units and departments, leaders, employees within organizations	Higher education, Toyota, Lego, R&D department, Product Design Companies
Organizations participating or collaborating in external projects and solving problems	External engineering or construction projects, Golden Gate Bridge, Charles A. Ellis

The idea is used in organizational contexts. The first example is Cameron's studies of effectiveness as well as adaptive responses to conditions of decline in higher education (e.g., Cameron, 1984, 1985, 1986). In these publications, he reported from different studies, including 334 four-year colleges and universities (1985, 1986) and one study of 14 small colleges that had undergone a decline in both revenues and enrollments during the 1970s, where half of these had successfully recovered (Cameron, 1986, p. 546). Cameron referred to Rothenberg (1984, 1985, 1986; Cameron and Quinn, 1988) and used the terms janusian thinking and janusian institutions (Cameron, 1984), distinguishing between psychological paradoxes (that can lead to enhanced creativity and cognitive adaptation) and organizational paradoxes—that can lead to improvement in effectiveness (Cameron, 1985). He argued that successful adaptation, especially under turbulence, almost always requires the implementation of simultaneously opposite strategies (Cameron, 1985), "the presence of simultaneous opposites in organizations that are highly effective" (1986, p. 547). He concluded that the institutions that managed paradoxes successfully recovered (Cameron, 1985; 1986, p. 546; Cameron and Quinn, 1988, p. 8).

Later in the 1980s, Eisenhardt and Westcott (1988) explored "the role of paradox in creating innovation and excellence through the example of just-in-time manufacturing" (p. 196), using mostly secondary materials (p. 192n). The Toyota leaders paradoxically framed their goals (p. 191) with juxtaposing goals, such as low costs and high specialization, low or no inventory, yet immediate access to parts (Eisenhardt and Westcott, 1988). Their study of the just-in-time manufacturing process is referred to in later arguments for paradoxical frames (e.g., Smith and Tushman, 2005; Lewis and Smith, 2014; Smith, 2014).

A third example is Osono, Shimizu and Takeushi's (2008) study of Toyota over six years using documents and 200 interviews between 2003 and 2007, where they identified six contradictory tendencies at Toyota that were helpful in understanding Toyota's success. These contradictions, opposites, and paradoxes were also self-generated and deliberately imposed: "Management orchestrated contradictions, opposites, and paradoxes" (p. 8). They called Toyota an organization powered by creative contradictions; the company actively embraced and cultivated contradictions instead of passively coping with them (p. 8).

Another example of organizational or management work with oppositions is from an action research project in the Danish Lego Group (Lüscher and Lewis, 2008). This organization launched extensive change efforts in 1998, which involved the reduction of managers and the implementation of self-managed teams. In the manufacturing division they studied (action research process), the changes created a series of dilemmas that paralyzed middle managers. It was only when the middle managers managed to work through paradoxes (with help from the authors to adopt a paradoxical frame) and shift the lens in sensemaking (p. 237) that they were able to creatively reinvent their roles. They reached a new and more enabling understanding of contradictory managerial demands (p. 239). Tensions were connected to the need to control and empower teams. This example involved assistance from action researchers.

Finally, in a four-year study of seven so-called product design companies using 114 informants, Andriopoulos and Lewis (2010) found that several of them managed to be ambidextrous companies that managed to focus on

both short-term survival (exploitation) and long-term adaptability (exploration). Paradoxical thinking (*both-and* thinking) was a key (p. 118). Among the examples above, two did not refer to Rothenberg (Osono et al., 2008), one of them indirectly through Cameron (Eisenhardt and Westcott, 1988), and the other discussed basic characteristics and differences between Western and Eastern philosophies.

To summarize the relevance in relation to the simple framework presented earlier, the following can be emphasized: One example (Osono et al., 2008) did not build on Rothenberg, which indicates that there other sources of the idea. All five examples illustrate positive output connected to working with paradoxes or using paradoxical frames. However, its possible relevance is not that simple. First, these examples are not representative of organizations in general; they are only examples for illustration. In all these cases, paradoxical frames were connected to positive effects, such as managing to become ambidextrous organizations, janusian institutions, effectiveness, excellence, novelty, implementation of new roles, creativity, and innovation. In most of the examples, the idea was also connected to innovation-related concepts, such as novelty, creativity, and innovation (Cameron, 1984, 1985, 1986; Osono et al., 2008; Andriopoulos and Lewis, 2010). The hypothesis of a positive relationship between paradox and creative output is therefore rough and not nuanced. For example, it may both increase and decrease creative output (Calic et al., 2019). Second, the hypothesis needs to be clarified in relation to the concepts. Novelty is often understood as deviation from established procedures or knowledge (March, 2010), while "creativity is novelty that is subsequently judged successful. Novelty is a necessary, but not sufficient, condition for creativity" (p. 75). Although there are different conceptions in the literature, novelty, and creativity often refer to an earlier phase than innovation (Harvey and Berry, 2023; Rothenberg, 2024, p. 34). Innovation is often understood as the successful implementation (and spread) of something new. As March (2009) noted, most novel ideas are bad ones; that is, "they will subsequently be judged unsuccessful" (p. 75). When novel ideas are generated, it is also difficult "to anticipate which of them will be successful" (p. 75). Studies also show that dealing with paradox is easier said than done (Barker, 1993).

5. Conclusion

The purpose of this paper was to explore the interdisciplinary travel of a theoretical idea that paradoxes are opportunities for creativity and innovation and the empirical and theoretical arguments behind the idea. The focus has been mostly limited to Rothenberg as a source of formulating and developing the idea of janusian thinking. The theoretical and empirical arguments come from his research on creative individuals and were adopted into management and organization research in the early 1980s. The idea of januasian thinking can be seen as a theoretical justification of using paradoxical frames in organizational problem solving. The idea can also be seen as adopted into management and organization research (Cameron, 1984, 1985, 1986).

The relevance of the idea of paradoxical frames in an organizational context is briefly illustrated through five examples of studies. As an analytical lens, it can contribute to understanding problem-solving behavior and outcomes, as, for example, in the Eisenhardt and Westcott (1988) study. It can be seen as a variant of paradox- or problem-driven creativity, occasion, or opportunity of creativity. As a practical tool, the idea is about working with tensions, opposites, and paradoxes. For example, dilemmas (either-or thinking) can be reframed into paradoxes (*both-and* thinking). The chances of generating novel and creative solutions are probably dependent on the capacity and training of those working with tensions and paradoxes in organizations, as, for example, in the Lego example (Lüscher and Lewis, 2008).

As noted, several paradox scholars refer to paradoxes as sources or opportunities for novelty, creativity, or innovation, and some of these refer explicitly to Rothenberg's studies. It can be seen as a new hypothesis/theory that needs to be clarified. A preliminary conclusion is that the idea is more relevant in relation to novelty and creativity than to innovation.

The five organizational examples (in Section 4) are illustrations of the use of paradoxical frames. They are not representative of organizations in general. Future empirical studies could therefore explore how paradoxes (e.g., competing demands) affect creativity in different types of organizations and levels using case studies and other methods. Future theoretical discussions could, for example, follow up alternative sources of the idea that is not discussed in this paper, as well as theorize the idea.

Rothenberg (1969) also noted that opposites may be "elements drawn from disparate domains" (p. 583). When the just-in-time system in Toyota was created partly with inspiration from the American supermarket (Ohno, 1988, p. 26), a disparate domain, it has certain similarities with combinations of elements, which is also called the combination of diversity of knowledge (Østergaard et al., 2011). Cameron (1984) used the term janusian institutions (incorporating different types of opposites), where opposites are attributes of the organization. This

term janusian institution (a term rarely used today), has some similarities with the much more used concepts of ambidextrous organizations (ability to both exploit and explore) and hybrid organizations. These are two possible areas of future discussion.

Ethics and AI Declarations

An ethical declaration was not required. AI tools were not used in the preparation of this paper.

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Between Tradition and Agility: How Swiss Start-ups are Overcoming the Consequences of Individualisation Through Market Segmentation and the 'Lean Start-up' Approach

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Abstract: This study investigates how Swiss startups address the challenges posed by increasingly individualised customer needs through traditional market segmentation and Lean Startup principles. The ongoing process of individualisation is leading to a shift towards self-determination, different lifestyles and complex customer interactions. The diversity of customers is increasing, and start-ups are forced to respond methodically to this situation. Using a qualitative content analysis of 44 business plans submitted to the Swiss Innovation Challenge (2022–2023), the study identifies the methods and procedures employed by startups to manage this customer differentiation. The findings show that while traditional segmentation and qualitative data collection are widely used, Lean Startup elements—especially the build-measure-learn loop—are less consistently applied. The study concludes that a hybrid approach combining traditional and Lean Startup methods enhances customer-centric innovation. These insights have implications for startup support programs and future research on entrepreneurial adaptation in dynamic markets.

Keywords: Lean Startup, Market Segmentation, Startup, Customers.

1. Introduction

The process of individualisation has been a major theme for the past 40 years (Lobato et al., 2018), shifting from traditional societal structures to self-determination and individual autonomy (Beck, 1986). This global trend (Genov, 2013) affects various aspects of life, resulting in diverse lifestyles and complex customer needs (Reichwald, Piller & Möslein, 2000). This has significantly increased the complexity of customer interactions, making it challenging for startups to accurately capture customer data. Conventional approaches like market segmentation and analysis enable businesses to customize their products and services to address the requirements of various customer groups (Homburg, 2017; Pöchtrager & Wagner, 2018). However, response bias in market research can distort results (Galdas, 2017), making it crucial to adopt strategies to minimise this bias. For new companies, meeting market needs accurately is essential for success. The Lean Startup methodology offers a dynamic approach to product development under uncertainty (Ries, 2017).

Primary research questions are: (1) How do Swiss startups utilise traditional methods (market segmentation and market analysis) to address diverse needs of customers? (2) What role does the Lean Startup methodology play in helping these startups adapt to rapidly changing market conditions?

By analysing 44 business plans from participants in the Swiss Innovation Challenge, this study provides insights into the strategies employed by startups to manage customer differentiation and uncertainty. The findings highlight the importance of both traditional market research techniques and contemporary Lean Startup practices in fostering innovation and customer-centric product development. The paper is structured as follows: it begins by establishing the theoretical foundation through a discussion of the individualisation thesis, traditional approaches to managing increasing customer differentiation, and Lean Startup practices. This is followed by an empirical analysis of the collected data.

2. The Ongoing Process of Individualisation of Society

The theory of individualisation has been a topic of discussion in sociology for many years (Genov, 2013; Lobato et al., 2018). Individualisation is a megatrend which affects the economy and society (Kaufmann, 2021; Lombardinilo, 2022). This trend is observed globally (Genov, 2013) and is causing a long-term change that affects society as a whole and affects almost all areas of life (Stangel-Meseke, Hahn & Steuer, 2015). The concept of individualisation provides a theoretical framework to show how the impact of rapid social change on individuals. Individualisation leads to a breakdown of traditional structures that have long dominated. Social elements such

as gender, family, education, employment, religion and class have undergone radical changes as structuring forces (Beck, 1986; O'Connor, 2019). According to Schroer (2000), they force individuals to place themselves at the centre of their life planning and lifestyles. In other words, they represent a shift from heteronomy to self-determination (Ewinger et al., 2016). Higher levels of education and incomes, better opportunities for social and geographical mobility, and stronger welfare state security and control systems are main causes of this development (Stangel-Meseke et al., 2015; Volkmann, 2007). The push towards individualisation in (western) society has several dimensions: Liberation, demystification and reintegration (Abels & König, 2016; Burzan, 2011). Liberation involves releasing individuals from traditional constraints like class, religion, and family ties, and detaching them from traditional role models (Beck, 1986; Beck & Beck-Gernsheim, 1994; Ewinger et al., 2016; Woodman et al., 2015). Individuals are seen as the smallest unit, with socialisation occurring through them (Beck, 1986). During the process of individualisation, individuals liberate themselves from their families, breaking generational chains and shedding traditions (Curryer et al., 2018; Woodman et al., 2015). This leads to increased social and geographical mobility. Economic emancipation allows freedom in occupation choice and escaping family constraints, resulting in diversified lifestyles and cohabitation (Beck, 1986; Scheller, 2005; Huinink & Wagner, 1998). Disenchantment refers to the loss of traditional certainties associated with individualisation, which are provided by guiding norms and certainties of orientation (Burzan, 2011; Feldmann & Immerfall, 2021). The pluralisation of values, lifestyles, and options opens new possibilities for individuals but also pressures them to constantly make decisions and take responsibility (Beck, 1986). Individuals need to continuously reorganise their biographies, creating a baseline biography and bearing the risk of incorrect decisions (Beck & Beck-Gernsheim, 1994; Curryer, Gray & Byles, 2018; O'Connor, 2019). To reintegrate into society to some extent after breaking away from tradition, individuals require a new type of social integration (Beck & Beck-Gernsheim, 1994; Burzan, 2011). This may include new social movements, subcultures, experimental lifestyles, or different forms of family (Beck, 1986). Individualisation is increasing in all aspects of life, resulting in increasingly diverse customers with individual needs and complex desires (Reichwald, Piller & Möslein, 2000). This trend is changing consumer behaviour, leading to a growing demand for personalised products (Ewinger et al., 2016). Society is evolving into a multi-option environment, where individuals have access to a wider range of choices (Feldmann & Immerfall, 2021). Companies need strategies and solutions that consider individualisation and its impact on the customer. This leads to new demands on products and services (Stangel-Meseke et al., 2015).

3. Traditional Methods for Addressing the Issue of Customer Differentiation

Modern society is characterised by a high degree of individualisation, leading to an increasing diversity of lifestyles. As a result, people have different needs, desires and ways of living (Reckwitz, 2017). This profoundly affects companies and their interactions with customers, necessitating a more comprehensive grasp of customer needs and behaviours (González & Bello, 2002). Companies encounter the challenge of tailoring their products and services to satisfy unique customer needs. Market segmentation serves as an essential tool for visualizing and comprehending the diverse customer segments

3.1 Market Segmentation

Market segmentation means dividing a market into different groups of customers with similar needs. This helps to understand how customers react to products and marketing strategies (Pride et al., 2018). Dolnicar et al. (2018) describe segmentation as 'the process of grouping consumers into naturally existing or artificially created segments of consumers who share similar product preferences or characteristics' (p. 11). Markets very in terms of desired benefits, purchasing behaviour, and price elasticity, all of which influence their response to marketing programmes (Homburg, 2017). Given this, markets can be segmented in various ways to better address the diverse needs of customer groups. Identifying an appropriate segmentation scheme is critical for targeted marketing, product positioning, and successful strategies. Several methods exist for segmenting a market (Wedel & Kamakura, 2000; Kotler, 1997; Homburg, 2017):

- Geographic segmentation structures the market into different groups of customers based on geographic boundaries.
- Demographic segmentation reflects the characteristics of customers, including variables such as gender, age, family size and life cycle, education and income.
- Psychographic segmentation involves grouping customers based on their psychological/personal characteristics, lifestyle, attitudes and interests.

- Behavioural segmentation examines customer behaviour, their specific reactions, and their progression through the purchasing process.

Segmentation is a fundamental concept in marketing that helps organisations to align strategies with customers. It is a cornerstone of almost every marketing strategy (Dolnicar et al., 2018) and contributes to the success of a marketing strategy. Despite its importance, many companies still struggle with segmentation (Schlager & Christen, 2022).

3.2 Market Survey

In a diverse and pluralistic society, it is essential to understand customer needs and develop matching products and services. Market analysis has traditionally played a central role in this process (Pöchtrager & Wagner, 2018). Market research (collection of primary data), as a component of market analysis, is crucial in capturing and interpreting human behaviour and attitudes (Scheffler, 2020). Furthermore, it has been demonstrated that market research can assist companies in reducing uncertainty (Tomczak et al., 2023). In the context of primary research, often a combination of qualitative and quantitative approaches is used to collect data. Qualitative approaches encompass interviews or focus groups, while quantitative approaches involve standardised surveys (Sekaran & Bougie, 2016; Tomczak et al., 2023). It is important to note that even with complex methodologies and research designs, customers may not show the same behaviour in practice as was previously evaluated in the survey, caused by the so-called response bias.

3.3 Response Bias

Understanding and recognising response bias is crucial for evaluating study findings and making evidence-based decisions. Bias is any influence that distorts study findings (Galdas, 2017), preventing unbiassed consideration of a question. It can happen at any stage of research (study design, data collection, data analysis and interpretation of the data), response bias refers to any element that distorts study findings. Defined as the "systematic tendency to respond to a range of questionnaire items on some basis other than the specific item content" (Paulhus, 1991; p.17), it can affect both entrepreneurs and customers, leading to inaccurate conclusions (Baumgartner & Steenkamp, 2001). Common sources of response bias include:

1. Social desirability Bias: Respondents may give socially acceptable answers instead of accurate ones (Paulhus, 2002).
2. Acquiescence bias: Some respondents tend to agree with assertions regardless of their actual ideas (Baxter, Courage & Caine, 2015).
3. Confirmation bias: Respondents may focus on information that supports their preexisting beliefs (Nickerson, 1998).
4. Question wording and framing: The phrasing or framing of questions can affect the responses (Beratšová et al, 2016).
5. Order effects: The order of questions can impact responses (Israel & Taylor, 1990).
6. Cultural bias: Cultural differences can introduce bias in interpreting and responding to questions (Moss & Vijayendra, 2018).

To minimise response bias, various strategies can be employed such as using randomised question orders, employing unbiased language, and ensuring a representative sample of respondents (De Jong, Pieters & Fox, 2010). Additionally, analysing data for consistency and comparing results with alternative research methods can help identify and mitigate response bias (MacKenzine & Podsakoff, 2012).

4. The Startup way for Addressing the Issue of Customer Differentiation

Startups encounter a demanding landscape while developing and marketing new products or services amidst uncertainty (Ries, 2017). New companies have innovative business ideas, often based on a scientific or technological approach, and ambitious growth plans in scalable markets (Minsch & Can, 2020). In the Lean Startup process, evaluating feedback from minimum viable product tests is crucial. Entrepreneurs should be aware of potential errors, as personal and customer preferences may vary significantly (Eisenmann, Ries & Dillard, 2013). Biases can lead to misinterpretation of test outcomes and faulty decisions. Implementing effective bias mitigation strategies enhances decision-making and reduces the risk of failure (York & Danes, 2014). The Lean Startup approach offers a way of dealing with uncertainties caused by individualisation and other factors (Wang, Dai, et al., 2022).

4.1 Lean Startup Methodology

Lean Startup Methodology and other lean approaches have been widely applied by entrepreneurs during product development, emphasising close interaction with potential customers for feedback (Blank, 2013; Bortolini et al, 2021; Wang, Hongbin, et al., 2022). Lean Startup Methodology promotes experimentation with fast and regular feedback loops to test assumptions about customer preferences and expectations (Chen et al, 2024; Philippi, Kabous & Hinz, 2023; Ries, 2011). This approach facilitates validated learning, thereby enabling entrepreneurs to make informed decisions in dynamic markets (Blank & Eckhardt, 2023; Bortolini et al., 2021; Hinz & Eisenbart, 2019). Especially in uncertain and complex instances with rapid change, startups need to experiment and learn quickly to survive (Bortolini et al., 2021). When done in a disciplined manner, this approach helps startups avoid developing product offerings that are likely to fail, thereby preserving helpful resources (Eisenmann, Ries & Dillard, 2013; Silva et al., 2020).

Lean manufacturing approaches have evolved from industry settings to startups, with a focus on customer-centric product development (Blank, 2013; Ghezzi & Cavallo, 2020). A significant phase in this evolution involved combining the business model canvas with customer development and agile methodologies (Blank, 2013; Blank & Dorf, 2012). Another stage introduced disciplined experimentation, hypothesis testing, and iterating/pivoting (Wang, Hongbin, et al., 2022; Ries, 2011). Depending on the outcomes of these test, it may be necessary to adjust product offerings or business model elements (Blank & Dorf, 2012; Hinz, Philippi & Kabous, 2023). Minor adjustments (iterating) facilitate rapid experimentation and alterations (Blank & Dorf, 2012; Bortolini et al, 2021; Ries, 2011). Conversely, major adjustments, also termed pivoting, involve the formulation of novel hypotheses and experiments (Bortolini et al., 2021; Silva et al., 2020). A Pivot can be regarded as course correction in response to changing customer preferences or new technologies (Silva et al., 2020; Ries, 2011).

Following the reviewed literature, this research puts particular emphasis on the following elements of Lean Startup Methodology:

1. Connection between vision, strategy and product: A distinct entrepreneurial vision is instrumental in guiding the strategy and product (Bortolini et al., 2021). The vision remains constant, while product features may be adjusted through iterations (Blank & Dorf, 2012; Bortolini et al., 2021). If iterations fail, the strategy is recalibrated, leading to significant changes (Blank & Dorf, 2012; Silva et al., 2020; Ries, 2011).
2. Close and regular interactions with (potential) customers: Lean Startup Methodology emphasises close interactions and early involvement of potential customers to understand their expectations (Ries, 2011). Receiving direct feedback is crucial for developing and improving the product (Bortolini et al., 2021; Hinz & Eisenbart, 2019).
3. Development of minimum viable product (MVP): Lean Startup suggests creating an MVP, a modest version of the product, for rapid and inexpensive development. An MVP is a sleek version of the product that facilitates quick and cost-effective development (Ries, 2011). It enables potential customers to provide regular feedback (Ghezzi & Cavallo, 2020; Ries, 2011, 2017) based on which startups adjust the MVP continuously and cost-effectively towards a successful final product (Balocco et al., 2019; Ries, 2011).
4. Experimentation with build-measure-learn loop: This loop enables startups to obtain validated learning on their product offering (Chen et al., 2024; Ghezzi & Cavallo, 2020). Startups formulate hypotheses on how potential customers may respond to the MVP (Bortolini et al., 2021; Ghezzi & Cavallo, 2020; Blank & Dorf, 2012). Based on customer feedback on the MVP, they can test their hypothesis and decide how to proceed (Blank & Eckhardt, 2023; Ries, 2011, 2017). Startups often iterate through multiple build-measure-learn loops.

The Lean Startup methodology emphasises close interaction with customers to obtain meaningful and direct feedback.

5. Methodological Approach

The study analyses 44 business plans from Swiss startups in the Swiss Innovation Challenge (2022-2023), an yearly competition comparable to an accelerator. The competition provides a consistent sample of innovative startups. The selection process, based on criteria like innovative strength, feasibility, and team strength, is evaluated by an experienced jury. In 2022, 25 participants and in 2023, 19 participants reached the final round (out of 100 teams at the beginning). All participants must hand in a business plan, creating a unique database

for this study. Nevertheless, it is acknowledged that startups may be compelled to formulate a business plan, even in instances where it does not align with their internal business logic. In such instances, the submission of a business plan is mandatory for the Swiss Innovation Challenge. To enhance the rigour of the analysis, the three researchers independently analysed the data sets and consolidated their results to minimise individual interpretations and enhance objectivity. The study evaluated market segmentation strategies (behavioural, psychographic, demographic, geographic) and whether startups used primary data collection (qualitative or quantitative research). Additionally, it examined the use of Lean Startup elements (vision-strategy-product, customer contact, MVP, build-measure-learn cycle) in the documentation.

6. Empirical Results

In the initial phase of the study, the objective was to ascertain whether the startups under analysis were using traditional approaches to engage with their customers. To achieve this, the study aims to enhance understanding of the methods used to collect empirical customer data and the application of customer segmentation. In the subsequent stage, the application of Lean Startup methodologies as a contemporary approach to systematically engaging with a customer base was examined.

6.1 Utilisation of Primary and Secondary Data

As previously outlined, societal evolution towards increased individualisation is precipitating a pluralisation and differentiation of its cultural fabric. This phenomenon is exemplified by the heterogeneity of customers and engenders a heightened degree of uncertainty, as needs become increasingly diverse and dynamic. Consequently, there is an imperative for sustained and intensive engagement with the market. Consequently, it is unsurprising that almost all startups have utilised secondary data on the market and its structure in their business plans. Only one team (out of 44) did not engage in this practice, opting instead to rely on their own analyses to address this deficit (Figure 1).

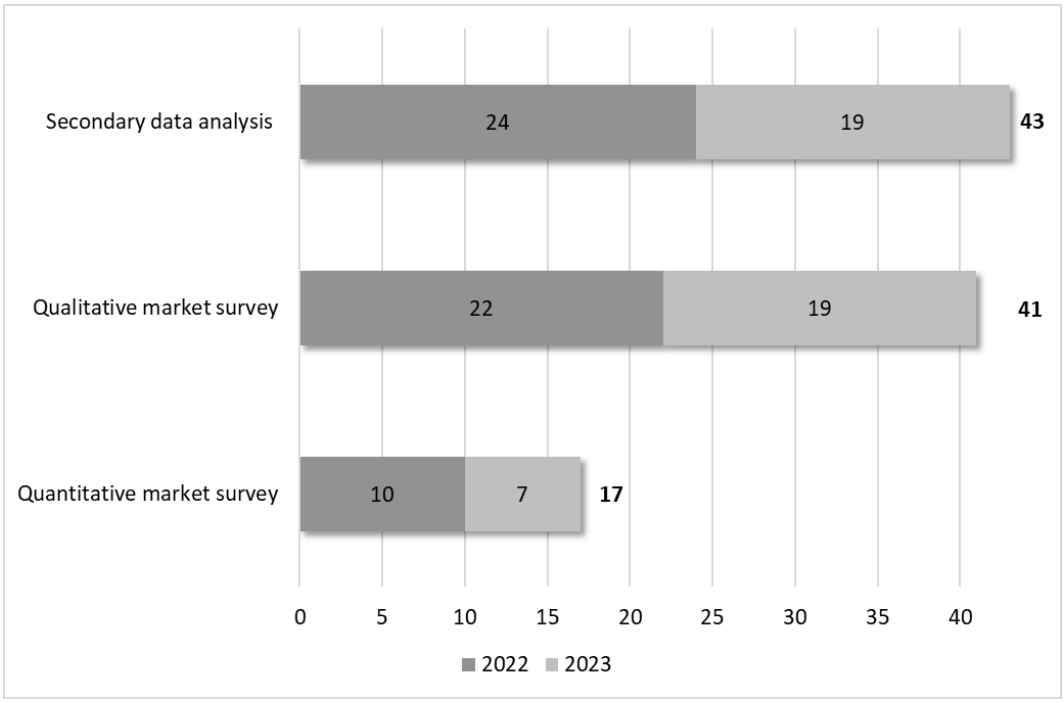


Figure 1: Utilisation of primary data (qualitative and quantitative) and secondary data

Looking at the use of primary data, most startups use qualitative methods to collect primary data (41 of 44). This is indicative for regular discussions with customers and attempts to establish a lively and intensive dialogue. However, it is evident from discussions with companies that this is rarely done systematically, thus precluding a comparison with a scientific approach to collecting qualitative data. This approach is more intuitive in nature, rather than systematic and structured.

A quantitative approach to collecting data is employed by only about one third of the startups (Figure 1). A more detailed analysis reveals that of the 17 cases employing a quantitative approach, 14 are in medical technology,

life sciences or pharmaceutical sectors. This is because clinical studies, i.e. quantitative procedures, are a prerequisite for obtaining authorisation for developed products. In contrast, only 3 startups from other areas rely on quantitative data collection. This is also hardly surprising. To be able to collect quantitative data, a solid database is required. Nevertheless, such a database is seldomly attainable due to a lack of financial resources to procure it or commission survey institutes.

6.2 Utilisation of Market Segmentation

As Dolnicar et al. (2018) observe, market segmentation is a core principle in marketing; it is therefore unsurprising that most (43 of 44) of the startups analysed carried out market segmentation (Figure 2).

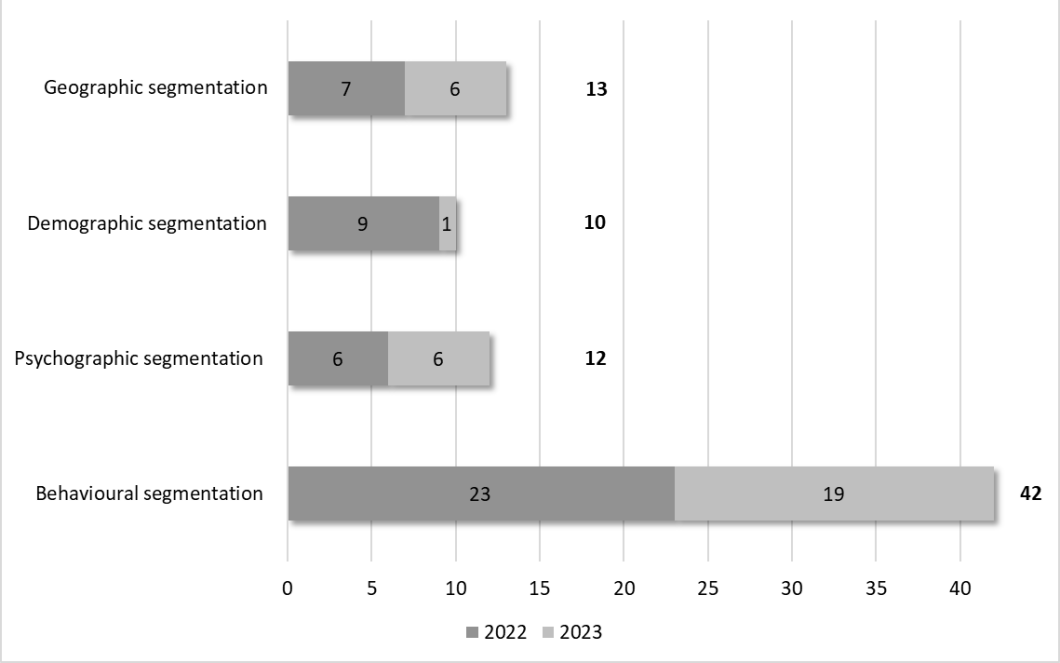


Figure 2: Utilisation of market segmentation

It is surprising that 'behavioural segmentation' was the most used form (42 of 44). This observation was made with a high degree of statistical significance. While this form of segmentation has proven to be remarkably beneficial, it is surprising that the other three types were not utilised more frequently. From our perspective, the limited attention (13 of 44) to geographical segmentation can be attributed to one factor. It is well-documented that nascent businesses tend to prioritise their home market, and due to Switzerland's relatively modest market size, it is often not economically viable to further segment and focus on specific regions. The under-utilisation of demographic segmentation (10 out of 44) can also be explained by a B2B market focus, which was evident in 36 of the cases analysed. Similarly, psychographic segmentation is more suited to a B2C model and is therefore less used in the B2B market. As a result, this approach to customer segmentation was used in only 12 cases.

6.3 Utilisation of the Lean Startup Approach

The objective of the study was to ascertain the way nascent companies address the challenges posed by an increasingly diversified society and an ever more intricate customer base. Conventional methodologies, encompassing the utilisation of secondary data and the collection of primary data, particularly in the form of qualitative approaches, are prevalent. The segmentation of markets to enhance customer clarity and enable structured management is also prevalent. However, this work also seeks to shed light into the application of newer approaches, especially those aimed specifically at startups. In this study, the popular Lean Startup approach is the focal point.

Lean Startup has become a prevalent approach for addressing entrepreneurial uncertainty (Bortolini et al., 2021). Consequently, it was hypothesised that most of the companies analysed would also adopt this approach. This concentrated on the four core principles (vision-strategy-product, close customer contact, MVP, build-

measure-learn). The application of three out of the four principles was deemed sufficient for the categorisation of a startup as adhering to the Lean Startup approach.

An examination of the results (Figure 3) reveals that our hypothesis was not substantiated. The analysis revealed that a mere 17 of the 44 cases under scrutiny implemented the Lean Startup approach. This outcome is somewhat surprising, and a higher utilisation rate was anticipated. This is particularly surprising given that the topic is addressed in numerous funding programmes and, according to our assessment, is discussed quite frequently.

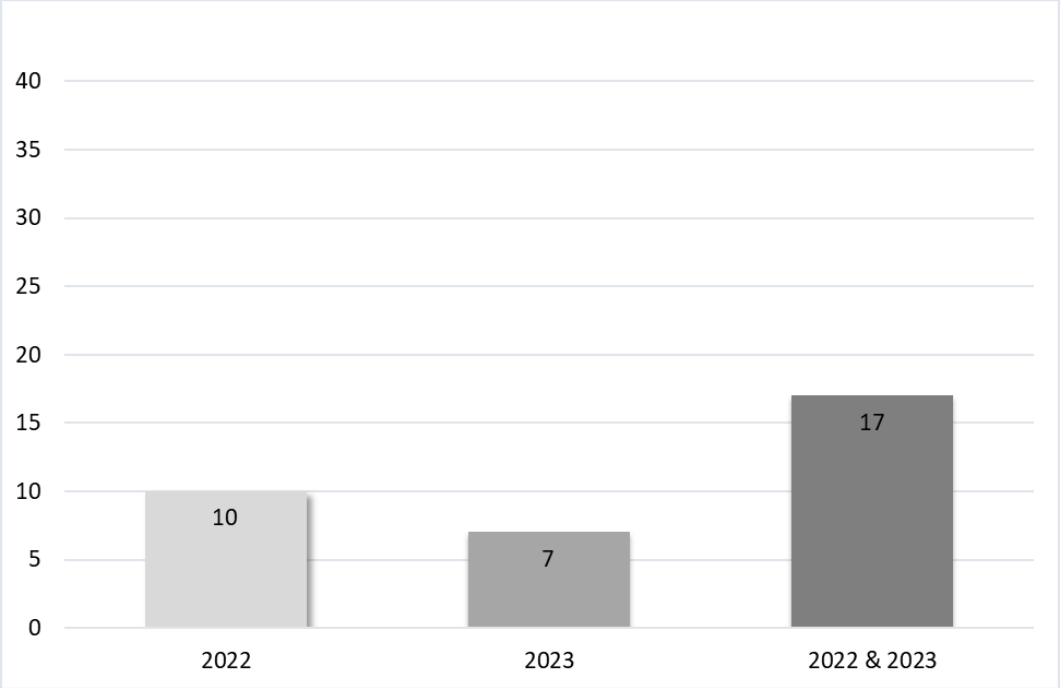


Figure 3: Utilisation of the Lean Startup approach

However, a more thorough examination of the four key elements indicates that three of them are employed with high frequency (Figure 4). For instance, 32 of the startups stated in their business plan that they maintain a close and intensive exchange with customers and ensure regular interactions. This finding corroborates the results related to the use of qualitative data, as illustrated in Figure 1. However, it is also noteworthy that not every startup that collected substantial qualitative data also claimed to prioritise close customer contact. Nevertheless, most startups provided information on both points. Furthermore, a vision and a strategy derived from it were also used frequently (30 out of 44). The existence of a clearly defined vision has been shown to facilitate the process of pivoting for nascent businesses. However, it should be noted that the utilisation of a vision and strategy is by no means exclusive to the Lean Startup approach. Indeed, these elements should be considered integral components of any comprehensive business plan. Consequently, it is somewhat surprising that only approximately two-thirds of young companies address vision and strategy in their business plans (Figure 4).

The term 'MVP' (minimum viable product) is clearly associated with the Lean Startup methodology. A review of business plans revealed that 27 of 44 of the startups reported utilising the MVP approach (Figure 4). Many of the analysed start-ups use the above-mentioned elements of the Lean Startup methodology. However, as mentioned earlier, we only found 17 cases that had a combination of at least three elements, resulting in a discrepancy between the use of individual elements and the use of the methodology as a whole. This discrepancy can be attributed primarily to a lack of awareness regarding the build-measure-learn feedback loop, which likely is a crucial core element. The findings reveal evidence that this iterative approach was employed in 12 of the 44 startups. It is acknowledged that not all startups disclose information in their business plans regarding the utilisation of an iterative approach. Nevertheless, a roadmap, the presentation of different product versions, or information on continuous improvement steps can provide insights into whether this approach has been utilized.

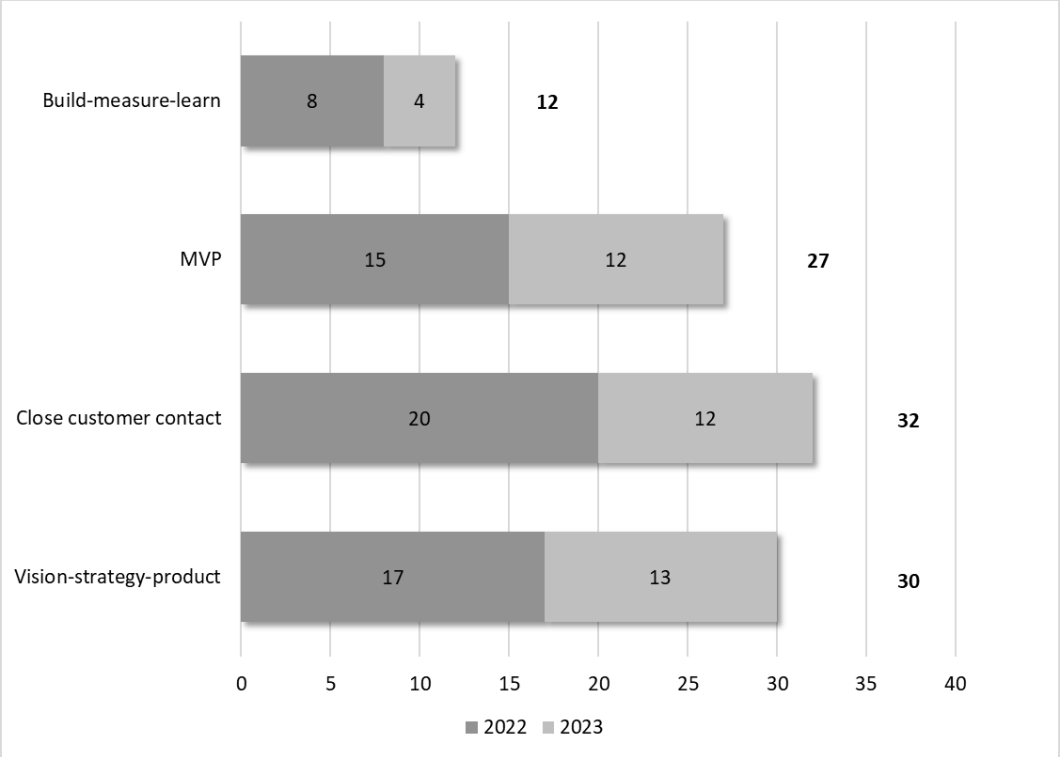


Figure 4: Use of the four key elements of Lean Startup

The findings suggest that startups more frequently apply conventional methodologies for market and customer management, such as market segmentation and market analysis, compared to Lean Startup approaches, even though they are specifically designed for startups. It is acknowledged that these approaches are not mutually exclusive and cannot be combined. Nevertheless, this study highlights the potential for Lean Startup approaches to be applied more frequently to enhance customer interaction and feedback measurement.

7. Conclusion

The study aimed to investigate how Swiss start-ups handle the ongoing process of individualisation. This process results in changes to consumer behaviour (Ewinger et al., 2016) and a diversification of customers and their needs. While traditional methods, such as segmentation and qualitative market analysis, are widely used, the study found that the full implementation of the lean startup methodology, particularly the build-measure-learn loop, is limited. Analysis of 44 business plans revealed that 98% of start-ups applied some form of market segmentation, with behavioural segmentation being the most prevalent. This aligns with existing literature (e.g. Dolnicar et al., 2018), which highlights segmentation as a fundamental aspect of marketing strategy. In contrast, however, only 39% of start-ups apply at least three core elements of the Lean Startup methodology. This indicates a gap between theoretical popularity and practical implementation. This is at odds with studies such as that by Bortolini et al. (2021), which suggest that lean principles are widely applied in early-stage companies. This discrepancy may be due to a lack of methodological awareness or resource constraints.

The results suggest that Swiss start-ups favour intuitive, experience-based approaches over structured, iterative experimentation. While this pragmatism may reflect limited resources, it also represents a missed opportunity to reduce uncertainty and improve product-market fit. Notably, the build-measure-learn loop is underutilised, despite being central to validated learning and agile adaptation.

A key strength of this study is its empirical basis in real business plans, providing authentic insights into start-up practices. However, relying solely on written documents may mean that internal processes or informal practices are not fully captured. Furthermore, as the sample is limited to participants of a specific innovation support programme, it may not be representative of the broader Swiss start-up ecosystem.

The results emphasise the value of combining traditional and agile methods. Start-ups that combine segmentation with iterative feedback loops are better able to cope with the complexity of the market. Policy makers and incubators could support this by providing targeted training on lean startup principles. Future

research should explore these dynamics through interviews and longitudinal studies to capture evolving practices and outcomes.

Ethics Declaration

This paper does not require ethical approval.

AI Declaration

To create the paper, DeepL was used to translate parts of the text from German into English, and the optimisation of text passages was conducted. Following further revision, the machine-generated suggestions were incorporated into the paper.

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Exploring Digital Innovation Issues in Luxury Hospitality Enterprises Towards EU Funding Status

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Abstract: The current study explores the trends of the technological advancements with regard to digital tools utilised by 4&5-star hotels, in order to identify how the relevant Cypriot market is in alignment with such innovative practices, leading oftentimes to improved entrepreneurial growth. Additionally, it emphasizes whether such enterprises are willing to implement such advanced instruments in order to ensure higher productivity, efficiency, and effectiveness. More specifically, this primary research strives to examine the strategic role of managerial decisions in applying cutting-edge technological tools and Artificial Intelligence (AI) in their operations in order to achieve sustainability and deploy innovation as well as ensure organisational resilience supported by EU funds. Empirically, qualitative study was conducted by tracing the views and experiences of 12 business executives within the Cypriot hospitality sector. Convenience sampling was employed by the research team to recruit potential participants before semi-structured in-depth interviews were carried out in the field, respectively. Moreover, through the perspectives of interviewees, the research offers insights of Cyprus' market reality, by taking into account that tourism constitutes the flagship of the country's economy. Findings indicate that digital innovation applications play a pivotal role in the ongoing digital transformation of the examined luxury tourism enterprises whilst they are prevalent used in certain internal and external functions ensuring enhanced organisational resilience and entrepreneurial competitiveness. Additionally, the support EU programmes, derived from the Green Deal, appear to be impactful on the establishment of the aforementioned digital equipment. Furthermore, conclusions, and recommendations provide a basis for future research on the specific topic, especially regarding certain EU policies contributed to enterprises' resilience process. Lastly, study's evidence could be useful to European and National institutions that deal with challenges towards digital transformation and formulate relevant policies as well as potential and active entrepreneurs in the field.

Keywords: Digital Innovation, Luxury Hotels, Cyprus, EU Funds

1. Introduction

Recent developments in the global economy have reshaped the way that the tourism industry is operating at a strategic level, hence, new challenges such as technological changes, security, innovation, to be considered as a major requirement for ensuring sustainable development (Dimanche & Andrades, 2024). Luxury hotels, such as those of 4&5 stars are facing increased challenges due to market shift, such as the travellers' experience, the alternative forms of accommodation, and the increased pressure by tour operators, to put more pressure for sustainable strategies (Luna-Cortés et al, 2022). Such practices should be viewed from a quality and brand image point-of-view, as sustainability has a direct positive impact on Customer Citizenship Behaviours (CCBs) and the much-needed Brand loyalty (Lin & Choe, 2022). Liu and Hu (2021) suggest that innovative branding is needed now more than ever before, hence, gaining improved market positioning and competitive advantage.

AI is experiencing a massive growth in the global economy, with its presence to be clearly visible in the vast majority of economic activities, thus, attracting the interest of both academics and professionals (Trabelsi, 2024). IMF (2024) strongly supports that AI will transform the entire global economy and will be more beneficial in advanced countries than emerging and low income (approximately 25%, 15%, and 10% respectively). However, companies should be extremely careful when implementing AI strategies, as despite obvious benefits in areas such as marketing and data analysis, problems such as poor customer experience due to human interaction may arise (Gonzales, 2023). Furthermore, the AI implementation should consider additional issues such as that of Cybersecurity which constitutes a real challenge for businesses that are not ready in terms of human capacity, knowhow, and technological infrastructure (Kaur et al, 2023).

AI and other digital tools have gained substantial position in the entire tourism industry, with operational fields such as marketing, room division, and food and beverage (F&B) to be amongst them (Belias et al, 2023). This enables the specific departments to become more independent in terms of strategic objectives and adjust to the new realities of the digital era which requires from the hotel industry to become more agile (Wynn & Jones, 2022). The positive effects of the AI implementation and other contemporary digital tools enables luxury hotels to implement branding strategies, therefore, reaching new market segments and strengthening their brand image (Djevojić & Vitasović, 2023). In any case, the integration of digital tools and AI should be viewed from a different perspective such as the Hotel Digital Capability (HDC) which requires the allocation of all appropriate resources (Fan et al, 2023).

Adopting AI and digital tools requires from organisations to comply with the existing legal framework in order to ensure that they will not engage into legal and ethical implications (Alqodsi & Gura, 2023). The European Union has responded rapidly to the implementation of AI in peoples' lives and businesses' operations, especially since AI has an impact on human rights and social issues (Kusche, 2024). The EU AI Act provides a rather holistic approach and is based on three major pillars, namely; understanding and assessing unacceptable risk, identifying high-risk applications, and ban unregulated high-risk actions as a result of AI (EU AI Act., 2023). This brings to the surface the need for contemporary hospitality businesses to educate its workforce in order to be able to comply with the emerging challenges and enable them to become more sustainable (Zhu et al, 2023). In this light, the current empirical study seeks to examine the evolution of the ongoing digital transformation in Cypriot luxury hotels by specifically focusing on the recent contributions of EU funds in the field of digital innovation and entrepreneurship.

2. Literature Review

The tourism and hospitality industry is an important economic sector of the Global and European economy that creates millions of jobs and contributes positively to the economic development of many countries. Its contribution has seen an increase over the years, and it is projected to exceed a value of $11.4 trillion by 2028 in terms of Global GDP (WTTC.org, 2024). This is an unprecedented increase from $8.8 trillion in 2019 (Hogenson Bray and Rugh, 2020). The sector is represented in 80% of small and medium-sized enterprises (SMEs) (WTTC, 2021) which makes it an even more important sector for many European countries since the backbone of the European economy is dominated by these companies (Suder, et al., 2024). The industry seems to overcome the setback of Covid-19 pandemic worldwide and arrivals have reached the pre pandemic numbers.

A particular niche part of the hospitality industry that has experienced a remarkable growth is the luxury hospitality market (Park et al, 2023). It is expected that this industry will increase from USD 93.4 billion in 2022 to USD 238.5 billion by 2028 (Fortune Business Insights, 2023). This is partly due to the general trend towards consumption of luxury items. Global spending on luxury travel accounts for approximately 20% of the total travel spending (Messe Berlin GmbH, 2018). Considering that luxury travel constitutes only 7% of all international travels, the economic impact of the luxury travel market is remarkable (Messe Berlin GmbH, 2018).

Hotels that are part of this market are operating in an increasingly competitive environment since the customers have become more demanding, looking for authenticity, high quality, innovative yet consistent and unique guest experiences offered in a seamless way. Luxury operators to offer the above experiences they need value added innovations which create more personalized experiences (Bharwani and Mathews, 2016). The innovations required in the luxury hospitality can either focus on the internal operations and processes or how their operational choices affect guests. A more ambitious innovation goal can be genuine guest-driven innovation (Johansson et al, 2024). This means that to succeed in this environment hotel companies need to undergo a digital transformation that require changes in the way they operate, market their brands, revenue models, structures and above all the company culture and strategy (Matt et al, 2015). There is a wide range of technology offerings that have been identified (Iranmanesh et al, 2022).

Other scholars have grouped the technologies into four groups: in-room, comfort, business essential and internet access (Liu and Hung, 2021). Park and Kim (2024) identified over 80 types of technology options in hotels while assessing customers' satisfaction and dissatisfaction related to technology. Overall, there is a shift toward smart environments in hotel operations and services due to the increasing availability and rapid evolution of technology amenities (Yang et al, 2021). Luxury brands like Marriott launched Artificial intelligent voice assistant and Four Seasons Hotel and Resorts are offering chat services 24/7 via chatbot (Cain et al, 2024).

The digital innovation and transformation that is required by the luxury brands faces though many challenges. Hospitality companies need to collect a vast amount of data and be able to analyze them and make sense of

them. There are a lot of additional channels for interaction with customer that need to be managed and evolving customer expectations in this new environment (Jain et al, 2023). The above means that companies on a European level but also in Cyprus need to use any possible means at their disposal to make the transition needed. EU has several funded programs to support digital transformation and innovation. It has put in place a massive recovery instrument called NextGenerationEU to deal with the aftermath of the Coronavirus and help EU countries and industries to create a greener, more digital and more resilient future. This instrument is expected to raise €712 billion by 2026, and the centrepiece of this effort is the Recovery and Resilience Facility (RRF) instrument. As part of the cohesion policies of EU, Cyprus has secured funds of **€**1.0 billion Euros (eufunds.com.cy, 2025).

Finally, another initiative launched by the EU commission is called Tourism transition pathway – Co-creation and co-implementation process. This initiative is targeted exclusively towards boosting the tourism economy and helping to accelerate the green and digital transition of the tourism economy and its ecosystems (Europa.eu, 2021).

Our study aims to contribute theoretically and empirically to the literature streams of luxury hospitality and digital innovation. First it provides an overview and context on the theme of luxury hospitality which is a topic that can be viewed from different perspectives (Wirtz et al., 2020). It redefines what luxury hospitality is and enhances the theory around this topic. Second, many researchers have stated that there is a need for research focused specifically on luxury hospitality (Amatulli et al., 2020; Batat, 2021; Farmaki et al., 2021). Our research aims to address this research gap. Third our research is the first one to provide empirical insights on the nexus between luxury hospitality and innovation. It is a study that has practical implications for hotel businesses that are aiming to utilize the funding tools that EU can provide them. Luxury hospitality is a very important part of the industry in Cyprus, and it needs to be investigated further. Our attempt is one of the first to do so**.**

3. Overview of the Cypriot Tourism Product and Hotel Infrastructure

Cyprus is considered a popular tourist destination (Panayidou et al, 2024) wherein the contribution of the hotel and catering sector to the Gross Domestic Product in 2023 was 6.3% and the total Gross Domestic Product in 2023 amounted to 29.8 billion euros at current prices (Pancyprian Hotel Association, 2024). Tourist arrivals in 2023 reached 3,845,652 increasing by 20.1% compared to 2022 with the main source of tourists coming from the United Kingdom with 33.9% of the total tourist traffic (Statistical Office, 2024). Worth noted that after the start of the war in Ukraine and the European Union sanctions against Russia, the arrivals of Russian citizens in Cyprus decreased sharply.

Prior to the aforementioned EU sanctions, Russia was the second most important market for tourism in Cyprus, holding 20% share of total tourism (Pancyprian Hotel Association, 2024). From 781,856 arrivals of Russian tourists in 2019, they were reduced to 65,803 in 2023 (Pancyprian Association of Hoteliers, 2024). In 2023, tourism revenues amounted to 2,990.6 million euros from 2,439.2 million euros in 2022, an increase of 22.6% (Cyprus Ministry of Tourism, 2024).



Figure 1: Tourist arrivals and revenues in 2000-2023.

Source: CYSTAT

Cyprus has 57,480 hotel beds, of which 14,204 in 5* hotels, 24,185 in 4* hotels, 13,801 in 3* hotels, 4,155 in 2* hotels and 1,135 in 1* hotels (Cyprus Hotel Association, 2024).

Table 1: Number of luxury hotel enterprises and bed capacities

Hotel Enterprises of Cyprus	5*	Beds	4*	Beds
	23	14,204	59	24,185

Source: Cyprus Hotel Association

4. Methodological Approach

Empirically, qualitative research approach was adopted, as considered adequate and effective in detecting and capturing personal perceptions, beliefs and experiences. The particular research method positively contributes to the exploration of entrepreneurship issues diversity and conducts in-depth insights (Apostolopoulos et al, 2019). It has the capacity to examine and clarify accurately the complexity of the phenomenon under investigation whilst analyses and specify entrepreneurship developments and emphasises notions, perspectives and opinions of interviewees. Furthermore, semi-structured interviews carried out achieving reliability of the examined issue. Twelve personal interviews were conducted with business executives coming from various places of Cyprus whilst followed by applying convenience sampling strategy. Table 3 captures key facets of the sample.

Table 2: Description of study sample

Respondent	Status	Area of Establishment
R1	Chief Operating Officer	Pafos District
R2	Chief Operating Officer	Pafos District
R3	Chief Operating Officer	Pafos District
R4	Chief Operating Officer	Pafos District
R5	Chief Operating Officer	Limassol District
R6	Front Desk Manager	Pafos Disctrict
R7	Front Desk Manager	Limassol District
R8	Quality Assurance Manager	Ammochostos District
R9	Administrative officer	Pafos Discrict
R10	Head of human resources	Pafos District
R11	Business Development officer	Pafos District
R12	Business Development officer	Pafos District

On average each interview lasted one hour. Interviews were conducted in March 2025. Additionally, deductive and inductive reasoning were applied while cross-checks were performed based on the main themes (Azungah, 2018). Table 4 illustrates the themes and sub-themes, respectively.

Table 3: Thematic Analysis

Themes	Sub-Themes	Insights
Digital transformation & the role of EU financial tools	- Evolution of digital transformation and technological establishments - EU funding programmes towards digital and green transition	• Recovery and Resilience Facility (RRF) instrument

Themes	Sub-Themes	Insights
	- Incentives that drive entrepreneurs to utilize EU funding opportunities - Barriers in accessing EU funding sources	• Reflection on investment capability and funding accessibility
Usefulness of digital innovative applications.	- Field of digital innovation implementation within hotels - Type of tools - Existing benefits and obstacles - Customer experience - Digitalising energy systems	• Innovative strategies • Facilitating operations • PMS - increase employee productivity, improve operating efficiency.
Building resilience & enhancing competitiveness	- Level of adaptability and performance - Trait and process of resilience / withstand and rebound from successive crises innovation - Business strategies and competitive advantage	• Strengthen procedures • Utilising digital opportunities

5. Findings

5.1 Digital Transformation & the Role of EU Financial Tools

Respondents claimed that digitalisation process in the Cypriot hotel sector generally has not yet reached a decent level. Specifically, some of the interviewees stated that the whole digital transformation is still in its infancy. Previously, they have embraced digital technology and modern applications especially in terms of organizational practices.

''*Digital tools offer solutions in different level within hotel. There is an ongoing digitalisation process and undoubtedly EU funding is very helpful, when it comes to digital transformation." (R1)*

''We utilized funding of Recovery and Resilience Facility (RRF) instrument, for digital establishments'' (R2)

''There exists specific financing namely from Recovery and Resilience Facility programme. It includes two main pillars, the green transition & the digital one. We got funded for second aspect. Mainly, for the needs of front desk services and customer experience such is virtual reality advancements. However, towards the latter I would say that most luxury hotels in Cyprus use digital tools indeed but not so much the AI applications. Digitalisation is an ongoing effort nonetheless." (R3)

''EU funds currently are available. In the past, we received funding via EU programmes but this occasion was an supplementary fund alongside our own capital for the investment of digital practices in different departments within enterprise." (R7)

However, according to the executives, the luxury hotels based on the pre-existing background and oftentimes due to financial capacity, they have proceeded to the implementation of digital solutions and establishment of digital tools by simultaneously utilising EU funding sources. They assess the presence and availability of these funds very useful in financing the relevant digital equipment and other practices related to digital innovation within their enterprises.

''We have access to EU funds, nonetheless, but, we need something value target since we will offer money as well. The participation usually in n such plans is 30% to be offered by the business. Actually, it wasn't a bad choice in the past. We did get funded through NextGenerationEU." (R5)

Notably, most of the interviewees rated negatively the fact that EU support programmes requires the financial participation of the business concerning the investment / expenses of buying new equipment as they don't cover the overall cost.

"It's hard sometimes, you now, you have to offer capital too." (R9)

''You can gain a lot of benefits surely; we did that during previous years where we established certain digital innovations within operations. There is a participation price as well, so you need put some money whilst sometimes you get paid after offering initially the whole investment facing delays. But I feel it will be a successful selection." (R10)

Respondents claimed they have faced issues in the past towards the access to information provided by the relevant national authorities on funding programmes. Oftentimes, there is lack of information in the availability or the guidelines with regard to joining such EU programmes.

5.2 Usefulness of Digital Innovative Applications

Luxury hotel enterprises have applied digital practices through the use of novel digital instruments mostly, in the areas of financial services (such as using advanced software products for financial analysis and pricing procedures) and marketing and booking (such as utilising cutting-edge technologies like virtual tours, chatbots and real-time booking systems). At a certain degree they follow the trends of digital trends towards front office technologies by establishing new digital tools and relevant hardware equipment in order to share notifications that enabling staff to efficiently deliver prompt and tailored services. Additionally, when discussing the Cypriot landscape, they stated that AI applications it's not so popular and not vastly established within hotel operations generally. Lastly, energy efficiency systems were established using digital options, controlling and relevant indicators.

''We have adopted digital applications towards front desk. We have access to digital tools towards booking tasks and managing professionally specific issues as well. We use PMS as well." (R4)

"We now have digital tools be applied in various stages of operations and generally enhancing the better function." (R5)

"Anything towards main front desk is digitalised while focusing in booking and social media tasks as well. Digital innovation services are at the forefront using applications that facilitate the diffusion of information in order for quality provision to be carried out." (R7)

"We employed innovating approaches by establishing digital systems towards customer experience, services and energy efficiency. Self Service Technologies and AI security systems are established through this process of digitalisation as well as certain digital software products within the financial services." (R8)

Worth noted, hotel managers asserted that supplementary actions are needed when establishing advanced digital systems such workforce training and renovations.

''Upskilling and training of workforce is needed." (R2)

"Certainly, after you apply such tools in the operations, the staff must be trained respectively. You need to realise it quickly. Some of them are funded as well." (R6)

Ultimately, they feel that luxury hotels should keep focusing on employees since the human resources playing a pivotal role in customer experience and quality of services and should not be replaced, especially by AI applications.

5.3 Building Resilience and Enhancing Competitiveness

All respondents firmly believe that emerging technologies help hotel businesses become more efficient, improve customer experience, and drive growth. The specific advancements highlighted by the aforementioned business executives directly lead to become resilient ad overcome challenges towards successive crises such the recent energy crises or the heath crisis of Covid-19.

Luxury tourism enterprises prevalent use digital tools in certain internal and external functions ensuring better organisational resilience and entrepreneurial competitiveness. In addition, the support EU programmes, derived from the Green Deal, appear to be impactful on the establishment of the aforementioned digital equipment.

"Applying effective digital tool towards the staff and the functions lead to better organizational resilience." (R1)

"Resilience and sustainability are the key when you adopt smart digital practices." (R2)

"We have established smart systems for better administration and service provision at the same time mainly in the front desk and secondly within other departments such as the well-being services or the room smart devices and the customized services". (R3)

This paper also highlights the importance of fundamental marketing practices, such as user-friendly websites, fast and reliable/mobile-friendly websites, search engine optimization, social media engagement, content marketing and data-driven revenue management, in maintaining a hotel's competitive advantage in the dynamic world of hospitality.

The findings indicate that hotel enterprises need to dealt with a balance between embracing new innovative technologies and maintaining traditional procedures at the operational level to ensure organizational resilience, remain competitive, and drive revenue growth.

6. Discussion

The current research has revealed the strategic as well as emerging importance of digital transition in the tourism sector, with exceptional attention to be paid on luxury hotels, as these constitute a powerful part of the specific industry. The importance of incorporating cutting-edge digital tools in tourism has been clearly identified throughout the examination of the existing bibliography, which importantly, applies to a global scale (Iranmanesh et al, 2022). The recent work of Belias et al. (2023) provides a powerful guideline and understanding how the digitalisation of several luxury hotel departments, such as marketing, rooms divisions, and F&B, all crucial for their smooth operation and delivery of the expected quality.

The NextGenerationEU tool provides enormous opportunities whilst Recovery and Resilience Facility (RRF) can further contribute towards this direction as it provides several important supports which deals with aspects such as innovation, creativity, digitalisation, and sustainable development (Damiano, & Valenza, 2025) and opportunities for hotel enterprises to eventually present resilience. Towards the latter, current research's findings with regard to building organisational resilience are aligned with relevant studies in the field taking into account that interplay between resilience and organisational performance (Melián-Alzola et al, 2020). The digitalisation in the global luxury hotel industry is experiencing a constant growth, consequently, requiring from all stakeholders, especially those of the private sector, to adjust accordingly, this finding is consistent with the findings of other studies (Sanz-Lopez et al., 2024).

7. Conclusions

The changing environment of the global economy, especially that of tourism industry which has gone through some serious challenges over the past two decades, as a result of consecutive crises, requires from the luxury hotels to ensure innovative practices. This goes through incorporating cutting-edge technology which will enable them to take advantage of the opportunities provided in the global market, establish an improved working environment for the entire workforce, and most importantly, to ensure an improved customer experience. Working with both national and EU authorities can become a crucial factor towards this direction, can provide the appropriate guidance, and therefore, establish synergies that are essential in order to reach their strategic goals. Despite falling behind time in relation to other countries, the luxury hotels operating within the Republic of Cyprus possess the relevant experience that will drive them forward in relation to the under-examination issue. Big Data Analytics, Artificial Intelligence, Self Service Technologies and Robots, and Marketing tools, are only some of the emerging digital technologies that can provide the appropriate support to the luxury hotels.

Ethics Declaration

We hereby declare that no ethical clearance is required for the research / not applicable

AI Declaration

We hereby declare that no AI usage has been carried out throughout the conduction of the study and the preparation of the relevant manuscript.

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How to Boost Entrepreneurship and Innovation in Higher Education Institutions

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Abstract: Entrepreneurship and innovation are critical drivers of economic growth, employment creation, and societal development. Higher Education Institutions (HEIs) play a key role in fostering entrepreneurial mindsets and creating innovation-driven ecosystems. However, many universities face challenges, including rigid academic structures, limited industry linkages, and insufficient support programs for academic startups. Against this background, the purpose of this paper is to explore strategies to enhance entrepreneurship and innovation in HEIs by integrating entrepreneurship education, establishing innovation hubs, strengthening industry-academia partnerships, and improving access to funding and mentorship. A robust entrepreneurial ecosystem within HEIs requires a multidisciplinary approach that embeds entrepreneurship in curricula across disciplines. This includes experiential learning methodologies such as business simulations, bootcamps, project-based collaborations, and startup incubators, allowing students to develop problem-solving and risk-taking skills, as well as consider creating their own company as a way of employability. Additionally, faculty members' engagement in entrepreneurial activities, supported by incentives for research commercialization, is crucial for fostering a culture of innovation. This study examines INOPOL – The Entrepreneurship Academy of the Polytechnic University of Coimbra (PUC) – as a case study to illustrate how academic institutions can foster entrepreneurial ecosystems. The findings indicate that INOPOL has played a significant role in integrating entrepreneurship education, promoting innovation, supporting business creation, and facilitating collaboration between academia and industry. A key initiative, Poliempreende, is a national program that provides mentorship, networking, financial support, and incubation opportunities for student-led startups within the polytechnic education network. The results also point out the importance of strategic partnerships in strengthening entrepreneurial ecosystems, providing students with practical experience, mentorship, employment opportunities, and access to funding. Furthermore, the adoption of intellectual property policies that promote technology transfer and the valorisation of research outputs emerges as a crucial success factor. INOPOL has contributed to advancing PUC's third mission while providing a dynamic and transferable model for integrating entrepreneurship and innovation in higher education.

Keywords: Entrepreneurship; Innovation; Higher Education Institutions; INOPOL; Academic Incubators; Entrepreneurial Ecosystem.

1. Introduction and Background

In a global economy characterized by high competitiveness and rapid technological change, entrepreneurship and innovation have emerged as key drivers of job creation, economic diversification, and sustainable development (Proença and Soukiazis, 2023). Technological advancements and shifting economic and labour market paradigms highlight the need for individuals to have not only technical expertise but also entrepreneurial skills and abilities to enable them to deal with current world challenges (Ghina et al., 2017). In this context, Higher Education Institutions (HEIs) are in a favourable position to promote entrepreneurial mindsets and foster innovation-driven ecosystems by embedding innovation approaches into curricula, research, and community engagement (Porkodi et al., 2023; Oliveira et al., 2024). Recent studies further emphasize the importance of HEIs in promoting academic entrepreneurship and facilitating the creation of spinoffs as a means of transferring the knowledge produced by the research activities, thereby contributing directly to economic development (Pacheco et al., 2023).

Traditionally, universities have prioritized teaching and research, often within rigid disciplinary boundaries. However, this conventional model is increasingly being challenged by the demand for more agile, interdisciplinary approaches that bridge the gap between knowledge creation and its practical application and valorisation. Higher education institutions need, therefore, to advance into proactive agents of change, equipping students, professors, researchers, and staff with the competencies, tools, and opportunities required to transform knowledge into innovation through new products, services, or ventures. This paradigm shift requires institutional strategies and policies able to integrate entrepreneurship into curricula, foster a culture of innovation, promote research outputs commercialization, and strengthen collaborations with external stakeholders (Etzkowitz et al., 2000; Pacheco et al., 2023; Oliveira et al., 2024).

In recent decades, the intersections between entrepreneurship, innovation, and higher education have become a growing area of interest in both academic and policymaking agendas (Etzkowitz et al., 2000; Guerrero and Urbano, 2012; OECD, 2019). Universities are no longer viewed only as centres for knowledge dissemination but as key actors in regional and national economic development through the generation, diffusion, and valorisation of knowledge.

Against this background, one relevant topic in the literature is the integration of entrepreneurship education into academic curricula. According to Fayolle and Gailly (2008), entrepreneurship education enhances students' entrepreneurial intentions and self-efficacy by providing them with the knowledge, skills, and attitudes needed to identify and exploit opportunities. Business simulations, startup bootcamps, and project-based partnerships are examples of experiential learning strategies that are particularly successful in encouraging active learning and practical application (Rae, 2006; 2007). More recently, Rodrigues (2023) also emphasized the significance of experiential and interdisciplinary learning methodologies such as design thinking and problem-based learning, which have shown significant potential in developing students' entrepreneurial mindset. These findings demonstrate the important role of HEIs in promoting entrepreneurial competencies through collaborative pedagogical models. Similar results have been reported by Santos et al. (2024), which support the idea that innovative active learning methodologies are an effective approach to enhance students' engagement and learning experience. Porkodi et al. (2023), in turn, give evidence of a positive correlation between institutional support and the development of entrepreneurial skills, highlighting the importance of creating an environment that fosters creativity, risk-taking, and innovation. Finally, Passarelli et al. (2025), in a recent comprehensive systematic literature review, point out that entrepreneurship education needs to evolve toward more holistic and multidisciplinary approaches. The findings ask for integrating fields like psychology, ethics, and neuroscience into entrepreneurship training to improve entrepreneurship education frameworks and therefore prepare more adaptable and impact-driven entrepreneurs. Nevertheless, many HEIs still lack the institutional flexibility to incorporate such innovative pedagogical approaches across disciplines.

Another critical factor discussed in the literature is the role of academic incubators and innovation hubs. These structures function as physical and intellectual spaces where students, researchers, and industry stakeholders can work together to transform ideas into new solutions and new ventures (Mian, 1997). Incubators not only provide infrastructure and support services but also foster a culture of entrepreneurship within the academic environment. Studies demonstrate that the success of such initiatives depends mainly on clear institutional strategies, leadership commitment, and sustained resource investment (Grimaldi and Grandi, 2005). In the same view, Marques et al. (2023) point out that non-formal and informal entrepreneurial learning activities, especially those developed in collaboration with external stakeholders, can significantly enhance entrepreneurial learning outcomes. Their work underlines the role of co-creation and inter-organizational collaboration in shaping successful innovation ecosystems within HEIs.

The literature further highlights the significance of industry-academia partnerships in fostering innovation. Collaborative activities with business partners enable HEIs to align research agendas with market needs and enhance students' employability through internships, mentorship, and co-creation projects. Effective partnerships also contribute to a more dynamic innovation ecosystem by facilitating access to funding, real-world problem-solving opportunities, and commercialization pathways, mainly through intellectual property valorisation and academic entrepreneurship (Perkmann et al., 2013). In addition, the role of policy and intellectual property (IP) frameworks is also widely discussed. According to OECD (2009), supportive policies at the institutional and national levels, such as entrepreneurship strategies, funding support schemes, and IP regulations, are critical for empowering technology transfer and the entrepreneurial exploitation of research outputs.

Overall, the insights from the above literature review demonstrate the need for a holistic and systemic approach to promote entrepreneurship and innovation in higher education. There is a consensus that successful entrepreneurship education and innovation in HEIs require coordinated efforts across curriculum, infrastructure, institutional culture, leadership, and policy frameworks. However, while progress has been made, substantial barriers remain, particularly in effective implementation, interdisciplinary integration, and sustainable ecosystem development.

The present study aims to contribute to this debate by examining a case study within the context of a Portuguese higher education institution - the Polytechnic University of Coimbra (PUC), a public institution recognized for its focus on applied sciences, innovation, and strong regional engagement. Founded in 1979, PUC serves over 12,000 students across six diverse schools, offering programs in engineering, education, health, management,

agriculture, and arts (see Figure 1). Specifically, this paper explores how PUC integrates the promotion of entrepreneurship into its institutional mission and contributes to a culture of innovation both within the university and in the broader regional ecosystem, focusing on INOPOL - the Entrepreneurship Academy at the Polytechnic University of Coimbra.

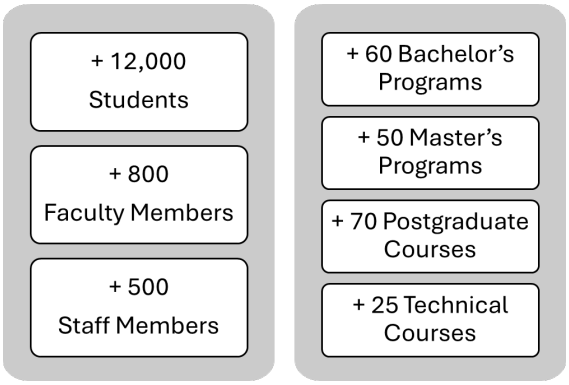


Figure 1: PUC´s characterization

The remainder of this paper is structured as follows: Section 2 outlines the methodology used in the empirical analysis. Section 3 presents and discusses the main findings. Section 4 concludes with key insights and policy recommendations.

2. Methodology

The paper employs a qualitative case study methodology to explore how Higher Education Institutions (HEIs) can promote entrepreneurship and innovation. Focusing on the PUC´s Entrepreneurship Academy, this research aims to identify and analyse strategies, practices, and institutional resources that support academic entrepreneurship and innovation. The case study intends to produce insights and good practices that can be adapted or replicated by other HEIs seeking to develop innovation-driven ecosystems.

The case study approach was selected as a research methodology due to its ability to provide depth and a holistic understanding of a bounded entity or phenomenon within its real context (Denzin and Lincoln, 1994; Burns, 1998). As Stake (2003) points out, a case study "is not a methodological choice but a choice of what is to be studied. By whatever methods, we choose to study the case" (p.134). This research design is particularly useful for exploratory and descriptive studies aiming to generate practical and context-specific insights.

The research methodology combines documentary analysis with institutional data collection. Data sources include a review of PUC's strategic and operational documents, such as institutional development plans, program guidelines, internal reports, performance indicators, and annual activity reports from 2021 to 2024. Additionally, the study draws on academic and policy literature related to entrepreneurship and innovation in higher education. Secondary data were therefore collected from relevant literature to contextualize the case, as discussed in the introduction.

The study is exploratory and descriptive in nature, aiming to generate contextual insights rather than test specific hypotheses. The primary goal is to understand how institutional frameworks, educational practices, and external partnerships converge to support the development of an innovation and entrepreneurship ecosystem within an HEI context. The exploratory design allows for the identification of emerging patterns and practices, while the descriptive focus provides a detailed account of the specific strategies and mechanisms implemented at INOPOL. Furthermore, the research aims to offer insights and contribute to the ongoing discussion on how HEIs can build and foster an entrepreneurial culture.

3. Findings and Discussion

The case study of the INOPOL – the Entrepreneurship Academy of the Polytechnic University of Coimbra (PUC) shows a comprehensive institutional framework for promoting entrepreneurship and innovation in a higher education context, rooted in strategic alignment, experiential learning, and ecosystem collaboration. The analysis allowed identifying three core dimensions contributing to the development of PUC's entrepreneurial environment: (1) strategic integration, (2) pedagogical innovation and capacity-building, and (3) ecosystem engagement (INOPOL, 2022).

The INOPOL, as an organic unit of the PUC, was founded in July 2021 at the initiative of the institution's presidency. Its creation was driven by a strategic goal to integrate and strengthen entrepreneurship and innovation initiatives, aligning with PUC's broader mission to promote applied knowledge and regional development. Designed to operate transversally across all PUC´s six schools, INOPOL is a hub for fostering an entrepreneurial and innovative culture, supporting early-stage ventures, and reinforcing the interface between academia and society (INOPOL, 2022).

From an organizational point of view, INOPOL functions as an Organic Unit for Training and Development Support, endowed with statutory, cultural, administrative, and disciplinary autonomy. This autonomy enables more flexible and dynamic operations while being coupled with institutional accountability mechanisms. Oversight is ensured by the PUC President and the Management Council, guaranteeing alignment with the strategic guidelines and activity plans approved by the General Council. INOPOL's governance structure comprises three key actors: the director, responsible for the unit's strategic and operational leadership; the administrative council, which manages financial and budgetary resources; and the strategic council, a consultative body supporting strategic planning and providing recommendations for systemic improvement. This governance model reinforces institutional legitimacy and promotes more effective operations. The strategic council ensures participation from diverse stakeholders, encouraging interdisciplinary collaboration and responsiveness to regional innovation dynamics. The definition of key performance indicators (e.g., number of incubated startups, participation in training programmes, intellectual property outputs) also reflects INOPOL's commitment to a results-driven innovation culture (IPC, 2024).

The documentary analysis gives evidence that INOPOL´s activity is centred on four main pillars (INOPOL, 2022), as follows:

i) Capacity Building and Networking

INOPOL promotes a wide range of programs and activities aimed at developing an entrepreneurial mindset among students, academic staff, and alumni. These initiatives include workshops, bootcamps, idea acceleration, pre-incubation programs, mentorship support, and networking events. They are based on experimental methodologies, such as design thinking, interdisciplinary teamwork, project-based learning, and real-world problem-solving, active learning approaches shown in the literature to be effective in entrepreneurship education (Rae, 2006; Rodrigues, 2023). The involvement of students and faculty from several academic backgrounds promotes interdisciplinary innovation and increases institutional impact. Additionally, the integration of external mentors, successful entrepreneurs, and alumni into INOPOL's training programs facilitates the transfer of practical knowledge and strengthens its connection to the entrepreneurial ecosystem. These practices align with Perkmann et al. (2013), who stress the importance of industry-academia linkages in fostering innovation.

ii) Knowledge Valorisation

The protection and valorisation of scientific and technological knowledge generated within the academic community is a central objective of INOPOL´s mission. To this end, INOPOL provides comprehensive support services to manage intellectual property (IP) assets and facilitate the knowledge transfer to society and industry. These actions are in line with the EU Guiding Principles for Knowledge Valorisation, which advocate the transformation of research outputs into societal and economic benefits through strategic IP management and stakeholder collaboration (European Commission, 2022).

INOPOL's services include providing specialized information on IP and relevant legal frameworks; support in conducting searches in IP databases; and assistance in preparing and submitting applications for patents, trademarks, and other forms of protection. The institution also manages the formalization and administration of IP rights attribution processes, ensuring proper legal and administrative follow-up, practices that are essential to maximize the potential of innovation (Teece, 1986). In addition to protection, INOPOL supports valorisation of these assets through diagnostic tools for IP use, technology transfer agreements, licensing support, and spin-off creation. These approaches are consistent with previous findings from Hladchenko (2016), which points out how universities can create surplus value by fostering collaborative knowledge flows between academia and industry. Moreover, INOPOL also promotes collaboration with companies interested in academic research outputs, reflecting the role of Technology Transfer Offices (TTOs) in academic entrepreneurship, as examined in the Italian context by Muscio (2013). These partnerships are central for shaping university spin-offs and commercializing research, which contribute to regional innovation systems (Clarysse et al., 2005). Recent

research also emphasizes that successful knowledge valorisation depends on a robust institutional framework that supports licensing, contract negotiation, and stakeholder engagement (Ramzi et al., 2023). INOPOL's approach thus reflects international best practices and strategic policy alignment for translating academic research into tangible economic and societal value.

iii) Business Incubation

INOPOL also functions as an academic-based incubator with dedicated infrastructure, including co-working spaces, incubation facilities, and access to research, development, and innovation (I&D+I) laboratories. This environment nurtures entrepreneurial growth by providing tailored support throughout the entrepreneurial journey, from ideation to venture creation and expansion. While the primary focus is on supporting startups and spin-offs arising from the PUC academic community, INOPOL's incubation services are also available to entrepreneurs from the wider regional ecosystem. This dual approach, which promotes both academic and regional entrepreneurship, improves INOPOL's role as a facilitator of knowledge-based economic development. Such hybrid incubators, integrated within academic institutions yet accessible to external members, have been shown to cultivate more robust innovation ecosystems by leveraging academic knowledge while addressing regional economic needs (Grimaldi & Grandi, 2005).

INOPOL's activities are enhanced by national programs like Poliempreende, the largest network promoting entrepreneurship within Portuguese polytechnic higher education. This program aims to stimulate creativity, innovation, and the development of entrepreneurial skills through a competition that includes both regional and national phases. Participants receive structured mentorship, training, and support in developing business plans, culminating in opportunities for funding and access to incubation (Paiva et al., 2019). These initiatives strengthen the support infrastructure for early-stage entrepreneurs and contribute to transforming academic research into business ventures. This approach is supported by previous research on academic incubators, demonstrating their effectiveness in facilitating new venture creation by offering access to resources, mentoring, and networks (Mian, 1997; Grimaldi & Grandi, 2005). Specifically, Mian (1997) shows how academic incubators benefit from access to intellectual capital, specialized facilities, and a culture of innovation, key factors also apparent in INOPOL's operation.

iv) Employability Promotion

A fourth strategic pillar of INOPOL is to support the employability of PUC students and graduates, focusing on facilitating their professional integration and supporting their career development trajectories. In this context, INOPOL implements targeted training programs that promote the development of transversal and future-oriented skills, thereby aligning graduates' competencies with current labour market expectations. This approach is consistent with findings from García-Álvarez et al. (2022), which point out that employers increasingly value transversal competencies such as critical thinking, adaptability, and communication in recent graduates. In addition to training, INOPOL provides support services, including career planning, active job search strategies, and professional integration activities. These initiatives contribute to bridging the gap between higher education and employment, a challenge well-documented in the literature (Abelha et al., 2020). Moreover, recent studies underline that project-based and experiential learning approaches, similar to those adopted in INOPOL's methodology, have shown significant effectiveness in enhancing student employability in higher education contexts (Li & Jansaeng, 2025; Proença et al., 2023). Such strategies not only reinforce the institution's commitment to student success beyond graduation but also align with international best practices advocating stronger academia-industry collaboration and the continuous development of employability skills.

When combined, these four strategic pillars demonstrate how a higher education institution can create and implement an integrated model that promotes entrepreneurship, facilitates knowledge transfer, supports regional development, and improves the employability of graduates.

The documentary analysis also gives evidence that a defining feature of INOPOL is its active engagement with external stakeholders, including local government, business associations, regional incubators, and private sector organizations (INOPOL, 2024a, 2023a). Strategic partnerships with these entities have enabled the co-creation of entrepreneurship and innovation programs tailored to regional economic needs and facilitated access to competitive funding, internships, co-innovation projects, venture capital networks, and pathways for applied research valorisation. These partnerships not only enhance students' entrepreneurial experiences but also ensure alignment between educational outputs and labour market needs (Perkmann et al., 2013; Marques et al., 2023).

The findings from this case study reinforce theoretical insights from the literature on academic entrepreneurship, which suggest that fostering entrepreneurship and innovation in HEIs requires more than isolated initiatives. INOPOL illustrates how a dedicated entrepreneurship unit, supported by institutional vision, leadership commitment, and strategic alignment, can drive the transformation towards an entrepreneurial culture within higher education (Etzkowitz et al., 2000; Porkodi et al., 2023). PUC's integration of entrepreneurship and innovation as a transversal and strategic axis in its institutional mission, along with an emphasis on hands-on learning, mentorship, and interdisciplinarity, reflects a model consistent with recent recommendations for more holistic and impact-oriented entrepreneurship education (Passarelli and Bongiorno, 2025; Rodrigues, 2023). The institutional commitment indicates the systemic change necessary for HEIs to fully embrace their third mission - contributing to social and economic development alongside teaching and research (Etzkowitz et al., 2000). Moreover, INOPOL's ability to engage with external stakeholders and integrate real-world challenges into its programs exemplifies the co-creation and ecosystem-building approaches recommended by recent research (Rodrigues, 2023; Marques et al., 2023). The case of INOPOL further illustrates the value of institutional autonomy in designing and implementing flexible and responsive entrepreneurship strategies adapted to local contexts. Its integrated approach, combining capacity building, incubation, and stakeholder engagement, represents a holistic model for embedding entrepreneurship within the academic environment. These outcomes reinforce the need for HEIs to develop systemic, cross-cutting strategies that promote innovation at all institutional levels. Moreover, INOPOL manages intellectual property (IP) and facilitates technology transfer, playing an important role in the valorisation of academic research. These activities have contributed to bridging the gap between scientific knowledge and market needs, addressing a common challenge faced by HEIs (European Commission, 2022; OECD, 2009). The institution also actively promotes integration into national and international innovation networks and consortia, leveraging external partnerships to support entrepreneurial activity and graduates' employability.

3.1 Impact Assessment

The analysis of INOPOL's activity over the period 2022-2024 reveals a consistent alignment with its institutional mission, producing measurable and meaningful outcomes across various strategic domains, as illustrated in Figure 1 (INOPOL 2025, 2024b, 2023b). Over this period, INOPOL implemented 224 activities designed to promote entrepreneurial thinking and innovation across the academic community. These initiatives reached more than 7,000 individuals (including students, graduates, professors, researchers, and administrative staff), underscoring the academy's institutional engagement. Furthermore, INOPOL provided direct support to 143 entrepreneurial projects and played a significant role in research valorisation, facilitating 62 intellectual property registrations and contributing to the creation of 10 spinoff ventures. The academy also incubated 35 startups, supported over 10 ignition projects and proofs of concept, and reinforced collaborative ecosystems by forming 46 institutional partnerships and participating in 13 multi-institutional consortia or network-based initiatives. Globally, these efforts contributed to raising €2.6 million in competitive funding, further consolidating INOPOL's contribution to a sustainable academic entrepreneurship ecosystem.

Table 1: INOPOL's key impact indicators (2022 - 2024)

Impact Area	Indicator	Value
Entrepreneurial Engagement	Total activities promoting entrepreneurship	224 activities
	Individuals reached (students, faculty, etc.)	Over 7,000 participants
Project and Venture Support	Entrepreneurial projects supported	143 projects
	Ventures receiving incubation support	35 ventures
	Ignition projects and proofs of concept supported	More than 10 initiatives
Research Valorisation	Intellectual property (IP) registrations	62 IP registrations
	Spinoff ventures created	10 spinoffs
Partnerships and Networks	Institutional partnerships formed	46 partnerships
	Participation in consortium/network-based projects	13 collaborative projects
Funding	Competitive funding raised	€2.6 million

4. Conclusion and Recommendations

Entrepreneurship and innovation are increasingly recognized as critical components of higher education's mission to prepare graduates for the complexities of the 21st-century economy. This study examined how the Polytechnic University of Coimbra (PUC), through its organic unit INOPOL Entrepreneurship Academy, has established a strategy to promote entrepreneurship and innovation within a higher education context. The INOPOL case study demonstrates how specialised, institutionally driven structures inside HEIs can support innovation, academic entrepreneurship, knowledge valorisation, and regional development. By integrating entrepreneurial capacity-building programs, technology transfer mechanisms, business incubation services, and employability initiatives, INOPOL has advanced PUC's third mission of contributing to societal and economic development.

The documentary analysis gives evidence that INOPOL has operationalized the vision of an entrepreneurial university by promoting interdisciplinary collaboration, engaging with external stakeholders, and embedding real-world challenges into academic practices. The outcomes, including the number of supported ventures, intellectual property registrations, and external partnerships, highlight the tangible institutional impact of this initiative. This approach reflects broader trends in academic entrepreneurship, emphasizing systemic, integrated, institution-wide, practice-based, and ecosystem-oriented strategies.

Nevertheless, several challenges remain that call for attention. First, the scalability and long-term sustainability of INOPOL's activities require consistent institutional support, including dedicated funding mechanisms and structural integration within academic programs. Second, while extracurricular initiatives have proven effective, a deeper curricular integration of entrepreneurial learning could extend participation and normalize innovation practices across disciplines. Third, equity and inclusivity in entrepreneurial engagement remain central to ensure that all academic community members can access and benefit from these opportunities.

Based on the findings of this case study, the following recommendations are proposed for HEIs aiming to strengthen their entrepreneurial and innovation capacity: i) Ensure institutional commitment and sustainable funding. Institutional leadership should continuously reinforce entrepreneurship culture as a core component of the university's mission and ensure stable and long-term funding sources, both internal and external, to maintain operational capacity and strategic autonomy. ii) Integrate entrepreneurship and innovation competencies within formal curricula, ensuring alignment with pedagogical best practices such as project-based learning, interdisciplinary collaboration, and experiential methods. iii) Invest in dedicated infrastructure such as incubators and innovation hubs that provide physical space, mentoring, and access to resources needed to develop entrepreneurial projects. iv) Establish incentives for faculty to engage in entrepreneurship education and research transfer, including funding, recognition, and career development opportunities. v) Enhance ecosystem collaboration. Partnerships with industry, government, and civil society to co-create innovation agendas, expand applied research opportunities, and connect academic entrepreneurship with regional and national development goals. vi) Promote internationalization and benchmarking, positioning within broader international networks of academic entrepreneurship to share best practices, access new funding opportunities, and benchmark performance against global standards.

In conclusion, INOPOL presents a dynamic and transferable model for including entrepreneurship in higher education. Its experience reinforces the view that institutional innovation, when guided by strategic direction and ecosystem-embedded, can significantly enhance a university's capacity to contribute to socio-economic development. By transcending traditional academic boundaries, INOPOL not only fosters interdisciplinary collaboration and stakeholder engagement but also delivers tangible outcomes, including startup creation, technology transfer, and regional partnerships, that reflect its measurable and institutional impact. Future studies should investigate comparative findings from similar initiatives across different higher education institutions as well as longitudinal effects.

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Ethics Declaration

Ethics approval was not required for the present study.

AI Declaration

The author acknowledges the use of AI-assisted tools for language refinement.

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Overcoming the Energy Crisis: Strategic Responses of Italian SMEs

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Abstract: Permacrisis is a term that captures the uncertainty of our era, marked by overlapping crises such as wars, pandemics, economic turmoil, and the looming threat of recession. In such volatile times, understanding how organizations adapt and thrive is critical, not just for survival but for future resilience. This study focuses on small and medium-sized enterprises (SMEs), investigating how they develop and leverage dynamic capabilities to effectively navigate crises. Using the energy crisis as a focal point, the research examines the strategic responses of twelve Italian SMEs through three critical phases of crisis management: pre-crisis preparation, in-crisis adaptation, and post-crisis recovery. Adopting a qualitative methodology, this research employs in-depth case studies to construct a comprehensive model that integrates process and variance analyses. By addressing the central research question—*how SMEs develop and use dynamic capabilities to gain competitive advantages in response to crises*—this study uncovers critical insights into organizational response. The findings reveal that SMEs implement tailored strategies for each crisis phase. In the pre-crisis phase, firms focus on risk anticipation, environmental scanning, and building resource flexibility. During the crisis, they engage in rapid reconfiguration, leveraging innovation and collaboration to mitigate disruptions. In the post-crisis phase, they consolidate lessons learned, embedding them into their operational frameworks to enhance long-term resilience. These efforts lead to the emergence of first-order dynamic capabilities, which, over time, evolve into second-order capabilities. This study highlights how these dynamic capabilities enable SMEs to navigate uncertainty, capitalize on emerging opportunities, even in adverse conditions. Furthermore, it provides actionable insights for practitioners seeking to enhance organizational resilience. By combining theoretical rigor with practical relevance, this research advances the understanding of crisis management strategies and the evolution of dynamic capabilities, contributing to academic discussions and providing a roadmap for fostering resilience in SMEs.

Keywords: Crisis Management, Dynamic Capabilities, Energy Crisis, Small and Medium Enterprises, Resilience

1. Introduction

In an era of constant uncertainty and overlapping crises, the term 'Permacrisis' describes an extended period of instability and insecurity, driven by a succession of catastrophic events (Collins Dictionary, 2022). From the COVID-19 pandemic to climate, economic, and geopolitical turmoil, the world has been grappling with global challenges that have severely strained economic, social, and political systems.

Small and medium-sized enterprises (SMEs) are particularly exposed to such crises due to their inherently limited financial and organizational resources.

Recent studies have shown that sustainable competitive advantage is rare and short-lived, especially in rapidly changing environments (Wiggins & Ruefli, 2002). Businesses should adopt strategies that explore temporary competitive advantages, which often require aggressive and innovative moves (D'Aveni et al., 2010).

The best strategy depends on the prevailing condition of resources and on the resources and capabilities of a company to adapt. Companies are beginning to understand that, to survive, they have to develop the dynamic capabilities of detecting crises, acting upon opportunities, and have to exploit their strategic reallocation of resources. These dynamic capabilities are the key in times of crisis for companies to see them through the difficulties and thereby transform these challenges into opportunities for growth (D. Teece et al., 2016; D. J. Teece et al., 1997). In this context, recent work by Sanasi and Ghezzi (Sanasi and Ghezzi, 2022) highlights how crises can act as inflection points that trigger strategic reorientations. They introduce the concept of the pivot—a deliberate, experimental shift in strategy aimed at responding to exogenous shocks under conditions of uncertainty. The pivot lens proves valuable for understanding how firms navigate disruption. Viewing crisis responses as sequences of reaction, experimentation, and learning allows us to interpret the strategic behaviour of SMEs not merely as a matter of survival, but as a potential pathway toward transformation.

While extant literature on dynamic capabilities and crisis management provides valuable insights, it often treats the development of these capabilities without accounting for the temporal evolution that crises impose (Khurana et al., 2022; Vasi et al., 2024; Teece et al., 1997). In particular, little attention has been paid to how SMEs activate and evolve capabilities across distinct crisis phases—pre-crisis, during the crisis, and post-crisis—especially in the context of sector-specific shocks like the energy crisis. This paper addresses this gap by asking: *How do SMEs develop and use dynamic capabilities to gain competitive advantages in response to crises?* By

examining this question through a temporal lens, we contribute to a more nuanced understanding of dynamic capability evolution in turbulent environments.

The paper is structured as follows: section 2 presents the literature review, examining key concepts in crisis management and dynamic capabilities; section 3 outlines the methodology, detailing the multiple case study approach; section 4 reports the findings, analysing firms' strategic responses across temporal phases and identifying emergent clusters; section 5 discusses the theoretical and managerial implications and section 6 concludes with a summary of insights and directions for future research.

2. Literature Review

2.1 Crisis Management

A crisis is defined as 'an unstable or crucial moment when a decisive change is imminent, especially with the distinct possibility of a highly undesirable outcome' (Williams et al., 2017). In an organizational context, crises are rare but critical events that stakeholders perceive as potentially devastating (Pearson & Clair, 1998). Effective crisis management involves the coordinated handling of complex technical and relational systems, strategic organizational design, and proactive efforts to shape stakeholder perceptions, ultimately aiming to prevent crises, mitigate their impact, and facilitate recovery (Bundy et al., 2017). As Williams highlights (Williams et al., 2017), the core goal of crisis management is to restore a disrupted or weakened system to its normal state, regardless of the crisis stage.

The literature on organizational crisis management typically differentiates strategic responses into three distinct phases: pre-crisis, crisis (during), and post-crisis (Coombs, 2007; Bundy et al., 2017; Herbane, 2019).

In the pre-crisis phase, it is crucial to focus on signal detection and preparation/prevention strategies (James & Wooten, 2010; Pearson & Mitroff, 1993; Waller et al., 2014). Additionally, fostering positive stakeholder relationships is vital in crisis prevention, as neglecting these relationships can increase the likelihood or severity of a crisis (Bundy et al., 2017). The "readiness model" emphasizes a multidimensional approach to preparedness, highlighting multilevel efficacy and mindset at the individual, team, and organizational levels(Jin et al., 2024).

In the crisis response phase, the focus shifts to containment and damage control (James & Wooten, 2010; Pearson & Mitroff, 1993; Waller et al., 2014). Organizations can adopt four strategic responses: retrenchment (short-term cost-cutting), persevering (maintaining the status quo), innovating (adapting business models), or exiting the market, depending on the crisis's impact (Wenzel et al., 2021).

Managers may take more risks during crises due to "loss framing," which can lead to organizational changes and the pursuit of opportunities (Foss & Saebi, 2017; Gooding et al., 1996; Shimizu, 2007).

In this phase, agility and rapid response capabilities have also gained prominence. Vrinda et al. (2024) analyse the role of decision-making agility in crisis management, showing how flexibility and swift responses enhance organizational resilience. They argue that integrating "crisis agility" into strategic processes can not only mitigate negative impacts but also support innovation and growth during adverse events.

In the post-crisis phase, the literature highlights two critical strategies: restoring business activities and organizational learning (Williams et al., 2017; Doern et al., 2019). The type and depth of lessons learned depend on various factors (Bundy et al., 2017). Recent literature emphasizes the importance of communication and resilience-building frameworks, suggesting that structured discourse and organizational reflection significantly enhance long-term recovery and future preparedness (Seeger et al., 2024).

2.2 Dynamic Capabilities

Ordinary capabilities facilitate the production and sale of a defined and therefore static set of products and services. These capabilities enable a firm to complete defined tasks with a certain level of competence, but do not necessarily support organizational growth (D. Teece et al., 2016).

In contrast, "dynamic capabilities" are defined as an organization's ability to "absorb, generate, and reorganize" internal and external competencies to successfully navigate a rapidly changing environment (Leonard-Barton, 1992). These capabilities are built on the organization's and management's abilities to understand and influence the environment, creating business models that exploit emerging threats and opportunities (D. Teece et al., 2016).

Helfat and Peteraf (Helfat & Peteraf, 2009) define dynamic capabilities as "an organization's ability to intentionally create, extend or modify its resource base." This view aligns with Danneels' (Danneels, 2002) call to integrate a dynamic perspective into the Resource-Based View (RBV) of the firm, which is essential to understand how firms evolve through the deployment and acquisition of resources, ensuring their survival through continuous renewal (Zahra et al., 2006).

In summary, dynamic capabilities are the engines that allow firms to not only keep pace with change, but to actively shape it for their success.

Teece et al. (D. J. Teece et al., 1997) organized dynamic capabilities into three clusters, forming the foundation of the literature. The first cluster, *sensing*, refers to identifying opportunities and threats early through cognitive and creative skills. *Seizing* involves mobilizing resources to create value via strategies like flexible sourcing and innovation. *Transforming* focuses on reorganizing the firm to stay competitive by encouraging adaptability and evolving business models (Khurana et al., 2022; Teece et al., 2016).

Recent theoretical advancements prompted a reconsideration of the traditional tripartite categorization of dynamic capabilities, suggesting a more nuanced perspective. Collis (Collis, 1994) introduced the concept of a capability hierarchy, proposing four levels of capabilities, with the fourth being 'meta-capabilities'—abilities to continuously renew capabilities, which can extend infinitely. Building on this, Danneels (Danneels, 2002, 2008) differentiated between first-order dynamic capabilities, which reconfigure existing resources, and second-order capabilities, which enable the creation of new first-order capabilities. This expanded view highlights the distinction between operational management (first-order) and strategic evolution (second-order) capabilities, offering organizations a dual focus on efficiency and long-term agility. This deeper understanding suggests the potential for exploring even higher-order dynamic capabilities to further enhance organizational renewal in a constantly changing business environment (Gupta et al., 2023).

More recently, Brock and Hitt (2024) proposed a distinction between meta dynamic capabilities, such as agility, building capability, and sensing, and strategic dynamic capabilities, such as ambidexterity, resource orchestration, and innovation, emphasizing the complexity and multidimensional nature of dynamic capabilities in multinational firms. In a complementary contribution, Brock et al. (2024) conducted a systematic review identifying twelve dynamic capabilities across international contexts, equally distributed between meta and strategic categories. These works enrich the dynamic capabilities framework with empirical examples and theoretical refinement, particularly in global and cross-border settings, and open the way to new research on capability interdependence and hierarchy (Brock & Hitt, 2024; Brock et al., 2024).

3. Methodology

The methodology adopted has been the inductive multiple case study (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Meredith, 1998), using a qualitative approach. The primary source of information was semi-structured interviews conducted with 12 Italian energy-intensive small and medium enterprises (SMEs). A total of 24 interviews were conducted, with two interviews per company, to ensure in-depth insights and enhance reliability. The interviewees selected for the study held senior positions such as owners, founders, or C-level executives, chosen specifically for their extensive knowledge (Meredith, 1998).

The multiple case study approach was chosen primarily due to its capability to generate robust findings through cross-case analysis, enabling comparisons across different cases. Such comparisons help identify if the observed phenomena are specific to individual cases or consistently emerge across various contexts, thereby increasing the external validity and generalizability of the study findings (Yin, 2018). Additionally, multiple case studies facilitate a deeper understanding of complex phenomena by examining them within their real-life contexts, thus providing rich and comprehensive data (Eisenhardt & Graebner, 2007).

The qualitative study incorporated secondary data sources, including academic articles, industry reports, and companies' official websites. The use of secondary sources enabled data triangulation, ensuring the reliability and validity of findings (Yin, 2018). By cross-verifying data from multiple sources, primary interviews, and secondary documentation, the study enhanced the robustness of its analytical conclusions and minimized potential biases.

4. Findings

Our study shows that firms responded differently to the crisis, and such differences depend on the development of new dynamic capabilities. Results highlight how the interconnections between the two dimensions, crisis response and dynamic capabilities, may be related. An integrative approach, combining insights from a temporal flow and a comparison between distinct clusters, generated the final model. Through this dual-method approach, it has been possible to realize a more finely understanding of the process of companies' adaptation to and innovation in crisis, putting front and centre how process- and outcome-oriented dynamics are interwoven.

Starting from the temporal flow, our framework examines how companies responded to the crisis chronologically, distinguishing three key phases: pre-crisis, during the crisis, and post-crisis. Each phase highlights the strategic choices made by companies and the corresponding capability developments.

In the pre-crisis phase, some firms demonstrated a preventive approach, anticipating potential impacts and proactively mitigating risks before the crisis fully unfolded. These organizations engaged in risk assessments, developed contingency plans, and implemented energy-efficient practices. A notable example is offered by A8, who reflected: *"In 2020, we realized that the cost per kilowatt-hour would quintuple in a short period. Therefore, we took action, informed ourselves, and tried to prevent it."* Companies with prior experience in navigating crises drew upon these lessons to enhance their preparedness. Others secured fixed energy contracts ahead of price surges, ensuring stable costs for up to two years. These initiatives not only improved their operational readiness but also laid the foundations for first-order dynamic capabilities such as Information Management, Alliance Management, and Risk Management. In contrast, other firms did not undertake any preventive actions, exposing themselves to greater vulnerability when the crisis hit. Some admitted to a lack of awareness regarding the escalating energy prices until the situation had already become critical. As A10 noted: *"The energy crisis was unpredictable and led to exorbitant costs for everyone."* These companies revealed significant gaps in their market monitoring and risk mitigation processes, making minimal efforts toward energy efficiency or strategic optimization. Consequently, they relied exclusively on their existing capabilities and missed opportunities to develop new ones.

As the crisis unfolded, companies adopted a variety of strategies to withstand the impact. A first group opted for retrenchment, focusing on immediate cost-reduction measures, including downsizing and suspending production during periods of high energy costs. A6 offered a clear illustration: *"In August 2022, we did not operate and moved production to September."* These strategies were primarily oriented toward survival rather than innovation, relying on established business-as-usual capabilities. Another group persevered through the crisis by maintaining core operations despite the difficult conditions. These companies adjusted prices, negotiated fixed-price energy contracts, or switched suppliers. Heightened vigilance over energy costs and external markets was common. As A2 explained: *"We paid what we had to pay, recalculated the impact on product costs, and redefined price increases based on the rising energy component."* While such firms avoided drastic measures, they did not engage in capability-building; instead, they drew upon existing resources to weather the storm. A smaller but distinct group embraced innovation, treating the crisis as an opportunity to develop new products, services, or processes. Through the adoption of new technologies and operational optimizations, they achieved notable performance improvements. A11 described their experience: *"We created an information Box Office for idea generation. Every week, we analysed these ideas and implemented small changes, ultimately fostering responsibility across the team."* These innovation-driven responses led to the development of first-order dynamic capabilities such as Resilience, Adaptive Leadership, Organizational Learning, and Process Innovation.

In the post-crisis phase, many firms concentrated on restoring business activities and returning to pre-crisis norms. As A2 succinctly expressed: *"After the crisis, we tried to put things back in their place."* These restoration strategies reflected a widespread focus on stability and continuity, primarily drawing on already-established capabilities to enable a smooth return to normal operations. However, some companies went further, using the crisis as a valuable learning opportunity. They embedded the lessons learned into their long-term strategies, thereby enhancing resilience and adaptability. For instance, energy monitoring routines introduced during the crisis were maintained and expanded. A12 highlighted the benefits: *"Thanks to our energy monitoring system, we can now identify waste and anomalies as they emerge."* These companies pursued lasting improvements in efficiency, refined production processes, and embraced digital innovations. Through this reflective and forward-looking approach, they developed second-order dynamic capabilities, including Inventive, Absorptive, Innovative, and Transformative capacities. Notably, firms that had developed first-order capabilities during earlier phases were better equipped to evolve toward second-order capabilities. Within this group, two subcategories became evident. Innovation-driven firms leveraged the crisis to drive continuous improvement

and growth, while transformation-driven firms fundamentally redefined their strategies and operations based on insights gained through the crisis experience.

Instead, cross-case analysis revealed three clusters of companies based on their responses and dynamic capabilities.

Table 1: Classification of firms based on their reaction to the crisis

Group	Companies	Initial Approach	Crisis Perception	Dynamic Capabilities	Outcome
Group 1 (Reactive)	A2, A5, A10, A12	Adopted reduction and perseverance strategies	Viewed crisis as a threat	Did not develop new dynamic capabilities	Focused on returning to normality; missed the opportunity to innovate
Group 2 (Adaptive)	A1, A3, A6, A7	Not well prepared but seized the crisis as an opportunity; adopted innovative strategies	Viewed the crisis as an opportunity	Developed first- and second-order dynamic capabilities	Became more agile and resilient in the long run
Group 3 (Proactive)	A4, A8, A9, A11	Excelled through prevention strategies and innovation	Recognized and leveraged the crisis	Strengthened both first- and second-order capabilities	Gained greater capacity for adaptation and transformation

After the crisis, firms that have succeeded in learning and developing second-order capabilities will leverage these to enhance their preparedness and strengthen their ability to prevent future crises.

By synthesizing the two perspectives and integrating both the temporal flow and the comparison between clusters, we created the final, complete, and robust model.

5. Discussions

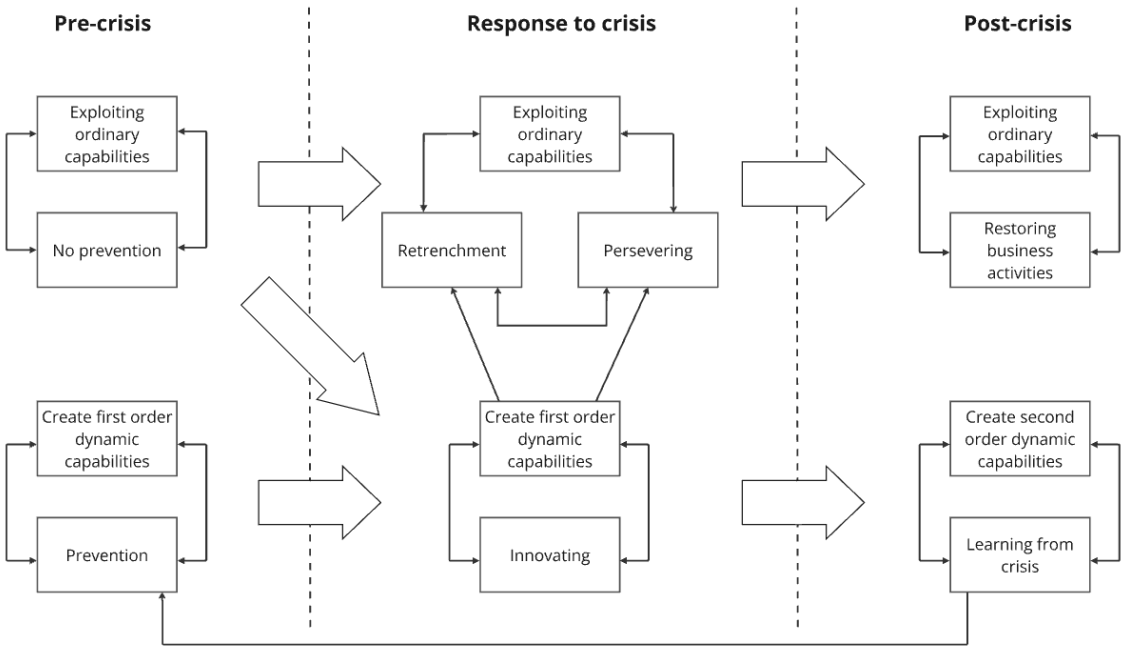


Figure 1: Conceptual framework

By examining the behaviour of SMEs during an energy crisis, this study sheds light on the dynamic capabilities needed to progress and overcome an exogenous crisis. Through the analysis of case studies, our research provides an in-depth understanding of the mechanisms that enable companies to transform crises into opportunities for innovation and subsequent growth. Figure 1 illustrates the final conceptual model developed from the empirical evidence.

While recent studies have advanced our understanding of dynamic capabilities in crisis contexts, they tend to present capability development as an undifferentiated process (Khurana et al., 2022; Vasi et al., 2024). What remains underexplored is how these capabilities unfold and transform across time. Our study addresses this gap by introducing a temporal perspective, segmenting the crisis response into three distinct phases: pre-crisis, in-crisis, and post-crisis (Teece et al., 1997; Danneels, 2008).

Through this lens, we show that SMEs activate different types of capabilities depending on the phase. In the pre-crisis phase, first-order sensing capabilities are essential for threat identification; during the crisis, first-order seizing capabilities support quick responses; and in the post-crisis phase, transforming and second-order capabilities aid in organizational reorganization and resilience improvement.

5.1 Contribution to Crisis Management

When adversity arises, astute administrators remain alert to hidden opportunities. Despite the ambiguity and potential threat posed by sudden changes, scholars argue that organizations should treat them as chances for experimentation and strategic redefinition (Haveman, 1992; Meyer et al., 1990). Our research aligns with this literature, distinguishing between companies that successfully prevented the crisis and those that did not. Companies that avoided the crisis were proactively prepared, enabling them to cope with changes and align with innovative trends, seizing emerging opportunities. In contrast, unprepared companies struggled with unexpected challenges. However, our findings show that a lack of preparation does not always prevent effective crisis navigation. Some companies, despite initial disadvantages, demonstrated adaptability and resilience, innovating and thriving through agile, proactive approaches.

Wenzel, Stanske, and Lieberman (Wenzel et al., 2021) outline four crisis response strategies: retrenchment, persevering, innovating, and exit. Our research shows that firms often combine strategies rather than relying on one—retrenchment, persevering, and innovation—while ‘exit’ is the only strategy that excludes others. Companies perceiving crises as threats typically use retrenchment and perseverance to cut costs and sustain operations. Conversely, firms viewing crises as opportunities may innovate while also retrenching and persevering to adapt. This multifaceted approach illustrates how blending strategies enhances resilience and responsiveness in uncertain environments.

When evaluating companies that viewed the crisis as an opportunity, our findings align with existing literature, showing that this perspective enhances strategic action, performance, and adaptability. Resourcefulness is crucial in crises, as Welter, Xheneti, and Smallbone (Welter et al., 2018) highlight in entrepreneurial activities. Firms using ambidextrous strategies—leveraging strengths while exploring new opportunities—respond more effectively. By recognizing and capitalizing on opportunities, companies can turn crises into advantages rather than mere threats (Wan & Yiu, 2009). Additionally, our research supports the link between perceiving crises as threats and rigid strategic responses. Decision-makers under pressure may experience “threat rigidity,” adhering to existing practices (Osiyevskyy & Dewald, 2018). This cognitive barrier hinders exploration, risking competitive loss from reluctance to adapt and consider alternatives.

5.2 Contributions to Dynamic Capabilities

Teece and Pisano (D. Teece & Pisano, 1994) and Teece et al. (D. J. Teece et al., 1997) identify three core elements of dynamic capabilities: coordination/integration, learning, and reconfiguring. Firms use sensing, seizing, and transforming mechanisms to manage resources and adapt to market demands. These first-order dynamic capabilities are vital for competitiveness in evolving business environments. Our research supports this framework but adds insights into their development stages. Sensing capabilities, identifying and assessing opportunities and threats, usually develop before a crisis, helping firms anticipate challenges and gain a strategic edge. Seizing and transforming capabilities are primarily activated during the crisis. Seizing focuses on leveraging opportunities through innovation, while transforming involves reconfiguring the organization to maintain resilience and performance. This temporal distinction underscores the importance of a phased approach to dynamic capability management. By developing sensing, seizing, and transforming capabilities at appropriate stages, firms enhance adaptability and crisis preparedness.

Second-order dynamic capabilities, or "meta capabilities," enhance first-order capabilities by improving a firm’s ability to "learn to learn" (Schilke, 2014). These capabilities affect performance through their influence on first-order capabilities (Khurana et al., 2022; Williams et al., 2017) and align with knowledge management frameworks, encompassing inventive, absorptive, and transformative capacities (Lichtenthaler & Lichtenthale, 2009). Our findings show that these capabilities primarily evolve during the post-crisis phase, suggesting their

development follows first-order capabilities. This challenges the view that second-order capabilities are prerequisites for first-order capability building. While literature suggests second-order capabilities drive adaptability (Danneels, 2008; Schilke, 2014; Winter, 2003), our research indicates the reverse: first-order capabilities are prioritized in crises, with second-order capabilities emerging later as firms refine their adaptive strategies.

6. Conclusions

This research examines the impact of the energy crisis on Italian energy-intensive small and medium enterprises, focusing on how they developed and implemented dynamic capabilities to address challenges. Through an inductive multiple case study, the research analysed three critical phases of crisis management: before, during and after the crisis. In the pre-crisis period, proactive preparation, including resource optimization and risk mitigation, is crucial. During the crisis, rapid and flexible responses enable firms to restructure operations and exploit new opportunities. In the post-crisis phase, companies consolidate changes and leverage lessons learned to develop second-order dynamic capabilities, enhancing long-term resilience.

The findings underscore that SMEs that were able to develop dynamic capabilities were capable to turn crises into growth and innovation opportunities. Therefore, integrating dynamic capabilities into SME operations is essential for strategic crisis management, enabling firms to adapt quickly, learn from experiences and transform crises into opportunities for long-term success.

We acknowledge the limitations of our work, which open promising avenues for future research. First, the study's temporal scope may not fully capture the evolving nature of dynamic capabilities. Moreover, it focus on SMEs and it excludes insights from larger enterprises. Additionally, the inductive research approach using multiple case studies may introduce bias due to subjective interpretations by both interviewers and interviewees, potentially distorting results. The reliance on a small sample size of twelve Italian SMEs further limits generalizability, particularly as the energy crisis is influenced by country-specific policies. Despite these limitations, the research can serve as a starting point for further exploration of dynamic capabilities in crisis management, especially across different contexts and over extended periods.

Ethical and AI Declaration

No ethical clearance was required.

AI tools were used for copy editing and proofreading

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Exploring the Microfoundations of Open Innovation: Insights from the Italian SME-Startup Collaborative Landscape

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Abstract: Small and medium-sized enterprises (SMEs) and innovative startups play a crucial role in driving economic growth and technological advancement. Open Innovation (OI) has emerged as a key strategy for these firms to access external knowledge and foster collaboration. However, while OI research has largely focused on large corporations or SMEs, limited attention has been given to the microfoundations that shape OI collaborations between SMEs and startups. This study addresses this gap by examining the individual and organizational factors that influence the success or failure of such partnerships. While both SMEs and startups face resource constraints and legitimacy challenges, they differ significantly in their market positioning, operational structures, and strategic priorities. SMEs typically have established industry expertise, stable customer bases, and access to financial resources, yet may struggle with rigid processes and risk aversion. Startups, in contrast, are characterized by agility, innovation-driven mindsets, and exploratory approaches but often lack financial stability, market access, and operational experience. These complementarities present both opportunities and challenges for OI collaborations. Adopting a multiple-case study approach, we analyse seven OI projects in the Italian context, each involving an SME and a startup. Through qualitative interviews and secondary data analysis, we identify key microfoundations that enable or hinder collaboration. Additionally, we introduce a framework to explore how different microfoundations interact, showing that enabling factors can yield mixed or negative outcomes when combined with other elements. This research contributes to the OI literature by providing a nuanced understanding of the micro-level dynamics that shape SME-startup collaborations. The study also offers practical implications for managers and policymakers, emphasizing the need for targeted support mechanisms that facilitate strategic alignment and mitigate potential collaboration frictions.

Keywords: Open Innovation; SMEs; Startup; Microfoundations

1. Introduction

Small and medium-sized firms (SMEs) and startups are pivotal in fostering innovation and stimulating economic growth (Simpson, 2004; Autio, 1997; Pushpananthan and Elmquist, 2022; Deschamps et al., 2013). Open Innovation (OI) facilitates access to external information despite constrained resources (Santoro et al., 2018), while OI research frequently emphasizes small enterprises over new ones (Brunswicker and Van de Vrande, 2014). Both face challenges regarding legitimacy and competency (Freel, 2003), whereas startups additionally lack skilled personnel, consistent clientele, and established procedures. Recent research connects human capital to open innovation through microfoundations (Chatenier et al., 2010), although it neglects the distinct requirements of SMEs and startups (Bertello et al., 2021; Corvello et al., 2024). This study investigates seven Italian SME-startup open innovation projects (Bertello et al., 2020), posing the question: "In what manner do microfoundations affect open innovation collaboration between SMEs and startups?"

2. Theoretical Framework

2.1 Open Innovation in SMEs and Startups

Small and medium-sized enterprises (SMEs) are vital drivers of innovation and economic development due to their flexibility and enhanced R&D productivity (Simpson, 2004; Autio, 1997; Audretsch and Vivarelli, 1996). However, limitations in manufacturing, distribution, and marketing often impede the commercialization of their inventions (Freel, 2003). Open Innovation (OI) has emerged as a strategic approach for SMEs to mitigate such constraints by leveraging external knowledge (Santoro et al., 2018). Collaborations with technologically diverse partners strengthen both product and process innovation (Bjerke and Johansson, 2015). Nonetheless, OI adoption introduces challenges: inbound OI may weaken internal technological capabilities, while outbound OI risks transferring key knowledge to competitors (Vanhaverbeke et al., 2002; Fosfuri, 2006). Financial limitations, infrastructure deficits, and partner selection issues also hinder SMEs' full engagement in OI (Bigliardi and Galati, 2016; Guertler and Lindemann, 2016).

Innovative start-ups are increasingly recognized as vital contributors to innovation, thanks to their agility and strong technological foundations enabling rapid development of new offerings (Pushpananthan and Elmquist, 2022; Deschamps et al., 2013). Despite this, research has focused more on established SMEs, overlooking start-

ups' specific challenges (Brunswicker and Van de Vrande, 2014). These include limited resources and "liabilities of newness": gaining legitimacy, building stable partnerships, and establishing long-term structures (Elfring and Hulsink, 2003; Gruber and Henkel, 2006; Aldrich and Yang, 2012). OI strategies can ease market entry and support innovative business models (Gruber and Henkel, 2006; Dahlander, 2007). However, partnerships bring substantial transaction and alliance management costs (Colombo et al., 2006). Establishing technological prestige via patents or product launches can enhance legitimacy and visibility (Teece, 1986; Stuart et al., 1999).

2.2 OI Microfoundations

OI's microfoundations stress organizational and personal factors influencing innovation potential and openness. Important human capital traits are adaptability, leadership, entrepreneurial attitudes, and techno-business thinking (Chatenier et al., 2010). Chesbrough (2003) underlined the movement of highly educated professionals. Intellectual stimulation and extrinsic incentives like career progress (Benkler, 2017; Ghezzi et al., 2018) are among the motivating factors. T-shaped knowledge, different social networks, and problem-solving experience (Jeppesen and Frederiksen, 2006; Dahlander and Frederiksen, 2012) further increase innovation potential. In SMEs, OI is guided in great part by CEO qualities including entrepreneurial orientation, patience, and education—entrepreneurial orientation, patience, and education—entrepreneurial orientation, patience, In start-ups, entrepreneurs' objectives, perceived behavioural control, and social conventions define partnership decisions (Corvello et al., 2024); internal attitudes and external forces influence openness (Simon et al., 2019).

Research on Open Innovation (OI) collaborations between SMEs and start-ups remains relatively underdeveloped, despite their strong potential rooted in complementary strengths (Bianchi et al., 2010a). SMEs possess in-depth local market knowledge and robust regional networks, which can help start-ups overcome early-stage barriers like limited legitimacy and access to critical stakeholders (Bhidé, 1999). In return, start-ups contribute advanced technologies and agile innovation processes, offering critical support to SMEs navigating digital transformation and maintaining global competitiveness (Ayala et al., 2017; Cavallo et al., 2021). These partnerships foster mutual learning and innovation synergies (Bleeke and Ernst, 1991; Harrigan, 1986; Sarkar et al., 2001). Italy presents a compelling case, with SMEs comprising 78.7% of the national workforce and producing 68.1% of total value added (Bertello et al., 2020). Legislative support, such as Decree Law 179/12, has encouraged the emergence of innovative start-ups (Troise et al., 2022). Yet, existing literature often examines either the SME or the start-up perspective in isolation. For instance, Corvello et al. (2024) examined start-up incentives to work with big businesses, whereas Bertello et al. (2021) examined SME capacities for participating in OI. This disjointed perspective ignores the relationship between start-ups' agility and SMEs' absorptive capacity, which is essential for productive cooperation (Cohen and Levinthal, 1990; Bogers et al., 2017b). Cultural mismatches—where start-ups' adaptable, informal nature may clash with SMEs' structured and risk-averse environments (Brunswicker and Vanhaverbeke, 2015)—as well as resource asymmetries, such as disparities in funding, expertise, and market access (Laursen and Salter, 2006), are some of the ongoing obstacles to these collaborations. To close this gap, the current study explores, using the following research question as a guide, the microfoundations supporting successful SME–startup collaboration in OI projects: "In what manner do microfoundations affect open innovation collaboration between SMEs and startups?"

3. Methodology

To explore the collaborative dynamics between SMEs and startups in Open Innovation (OI), this study adopts a qualitative, multiple-case methodology. The case study approach is particularly valuable for capturing the complexity of OI in real-world contexts, offering rich, contextualized insights (Eisenhardt, 1989). By employing a multiple-case design, the study enhances the robustness of findings through replication logic and reduces the influence of researcher bias (Eisenhardt & Graebner, 2007). The analysis centers on SME–startup partnerships, treated as dyadic units to facilitate comparative investigation across cases. This nested structure enables both depth and contrast, helping to surface patterns and divergences in innovation strategies—an important contribution given the limited empirical research in this area (Eisenhardt & Graebner, 2007). Analytical procedures include both within-case and cross-case analysis to uncover nuanced practices at the individual partnership level and synthesize broader trends (Miles, 1994).

3.1 Data Collection

Primary data were gathered through semi-structured interviews with managers, founders, and other stakeholders involved in innovation. Conducted mainly via web meetings for convenience, interviews averaged

45 minutes and explored OI partnerships' origins, management, outcomes, and challenges (Vanhaverbeke et al., 2012). The flexible format encouraged open sharing while ensuring comparability. Each interview covered two sections: (1) the collaboration's formation, motivations, and roles; and (2) outcomes, team structure, success factors, and encountered challenges. Supplementary data were drawn from company websites, internal documents, and industry reports. Follow-up interviews were conducted when new themes emerged. Purposeful sampling was applied to select SMEs (fewer than 250 employees and turnover below €50 million; Scuotto et al., 2017) and startups, defined as "temporary organizations looking for a repeatable and scalable business model" (Blank, 2010). From 15 eligible cases, 7 were selected, resulting in 18 interviews—consistent with sample sizes recommended for theoretical saturation in qualitative research (Eisenhardt, 1989).

3.2 Data Analysis

A case-by-case content analysis was performed on interview transcripts to identify microfoundations influencing OI partnerships. The first phase, open coding, extracted specific concepts from data, capturing organizational practices and strategic behaviours. These were grouped into second-order themes to reveal cross-case patterns (Clark et al., 2010), which were then organised into aggregate dimensions: enabling and limiting microfoundations (Silva et al., 2021). Enabling microfoundations facilitated partnership success, while limiting ones represented constraints. The framework from Barrett and Tsekouras (2022) guided clustering microfoundations by their source—SME, startup, or joint actions. Some microfoundations matched existing literature; others were novel. Cross-case analysis further refined classifications to deepen understanding, a step not needed in within-case analysis due to fewer observations.

3.3 Case Description

Table 1

I	Case I involved Startup A, an organic agricultural producer in Bergamo, partnering with SME I, a marketing consultancy. The goal was to boost market visibility via an omnichannel strategy, including sports partnerships. Success was driven by personal ties and trust but ended after a year due to funding and shifting priorities.
II	Case II featured SME II, a waste container manufacturer, collaborating with Startup B, an IoT smart waste management firm. The integration of IoT sensors into SME II's products was mutually beneficial, supported by strong interpersonal relations. Challenges stemmed from Startup B's limited business management experience and occasional generational friction.
III	Case III connected Startup C, a Milan-based textile startup innovating with marble powder, with SME III, a family-owned yarn dyeing firm. Initiated through a mutual contact and public grant funding, the collaboration led to a new patent despite technical challenges, enabled by regular communication and shared sustainability goals.
IV	Case IV described SME IV, an outdoor awnings manufacturer, partnering with Startup D, specialists in AI and IoT for industrial optimization. Starting with a fabric recognition system, the partnership expanded to a B2B client portal. The collaboration thrived on shared innovation goals and SME IV's preference for agile startup partners.
V	Case V involved SME V, an antivibration engineering firm, and Startup E, a university spin-off developing metamaterial-based acoustic control. Facilitated by a university hub, the partnership produced several projects but struggled in cost-sensitive markets. Strong personal ties sustained ongoing cooperation.
VI	Case VI focused on Startup F, an exoskeleton developer, working with SME VI, an assembly service provider. SME VI helped scale prototypes to production, overcoming Startup F's initial cost-cutting focus on favour of quality, which was critical for wearable tech success.
VII	Case VII detailed Startup G, an IoT antismog mask innovator, collaborating with SME VII, a respiratory equipment manufacturer. Initiated academically, SME VII supported product refinement, scaling, and regulatory compliance. Cultural clashes arose between SME VII's structured style and Startup G's iterative approach.

4. Findings

4.1 Startup Microfoundations

Early recognition or funding was pivotal in building trust with SMEs. Public funding in Case I-A validated the startup and lowered collaboration barriers, while awards in Cases III-C and V-E enhanced legitimacy. However, recognition alone did not guarantee sustained success. Alignment between startup innovations and SME strategic needs was crucial. In Cases II-B and V-E, startup technologies closely matched SME demands, particularly in digital and engineering solutions, driving collaboration initiation. Regarding behaviours, founders in Cases I-A, II-B, and III-C showed openness to partnership, aiming to improve offerings via feedback and

network access. Yet, resource constraints often limited sustained involvement. Delays by SMEs in Cases I-A, III-C, and VI-F stalled momentum, underscoring startups' dependence on ongoing SME engagement. Founder commitment—resilience and steady involvement—in Cases I-A, III-C, and V-E maintained trust despite funding shortages. In Case IV-D, startup adaptability to SME operational needs was key, but the lack of structured management and financial planning gaps in Cases I-A, II-B, and VI-F caused friction and timeline disruptions, requiring SME guidance.

Table 2: Startup Antecedent

Enabling	Limiting
1. External Validation and Credibility • Publicly Funded Startups • Winner of a funded contest	1. Resource Constraints • Limited Financial and Operational Resources Available to the Startup
2.Strategic Exploration of Emerging Technologies • Startup Founder's Novel Approach and Pioneering Vision • Interest in Exploring New Technologies and Sectors	
3.Openness to Innovation-Oriented Collaborations • Willingness of Startup Founder to Engage with Other Small Entities	

Table 3: Startup Behaviour

Enabling	Limiting
1. Startup Founder Commitment • Persistent Effort and Dedication by the Startup Founder	1. Limited Business Management Experience • Misalignment in Investment Priorities • Inadequate Prioritization of Strategic Focus Areas • Underestimation of Qualitative and Coordinative Challenges • Lack of Understanding of Business Processes
2.Startup Founder Flexibility • Ability to Rapidly Adapt to Project-Specific Requirements	

4.2 SMEs Microfoundations

From the SME side, antecedents acted as enablers and barriers. In Case V-E, the SME proactively sought external partners aligned with its innovation strategy, showing deliberate openness. SME managers in Cases II-B, III-C, and V-E provided startups with informal insights on technical norms, regulations, and product-market fit, helping with adaptation. SME resource commitment was critical: in Case II-B, the CEO approved the collaboration and allocated funding, stabilizing the startup's environment. However, commitment was inconsistent; in Cases III-C and IV-D, competing priorities and limited managerial capacity caused delays and stalled progress.

Table 4: SME Antecedent

Enabling	Limiting
1. Active Pursuit of Collaborations for Innovation • SME Managers' Receptiveness to Technological Innovation • Intentional Search for Collaboration with Startups	1. Capacity Constraints • High Workload Impacting the Availability for New Projects
1. SME Managers' Expertise • Extensive SME Managers' Expertise in the Sector	

Table 5: SME Behaviour

Enabling	Limiting
1. SME CEO's Resources Involvement • Commitment to Process Optimization and Quality Improvement • SME CEO Involvement in Startup Investment • Investment in a Patent	

4.3 Joint Action Microfoundations

In Case I-A, prior professional familiarity reduced the time to establish working terms. Similarly, in III-C, trust built through mutual acquaintances eased adjustments during difficulties, and IV-D's pre-existing relationship helped set early expectations. These informal networks lowered uncertainty and lent credibility, enabling focus on operational goals without lengthy trust-building. Interaction quality influenced progress. In III-C, the relationship was described as "familial," based on personal compatibility rather than formality. In I-A, IV-D, and V-E, shared values about business goals and decision-making fostered cohesion, making partnerships more resilient. Teams adapted to challenges rather than withdrawing. However, tensions arose when goals diverged. In VI-F, the startup's rapid innovation focus clashed with the SME's cost containment priority, causing friction. In II-B, misaligned timelines and investment expectations led to coordination breakdown, limiting continuity.

Table 6: Joint Action Antecedent

Enabling	Limiting
2. Established Personal Networks • Trust Established Through Previous Personal Relationships • Initial Contact Facilitated by a Mutual Connection	

Table 7: Joint Action Behaviour

Enabling	Limiting
3. Personal Compatibility • Development of Strong, Familial-Like Relationships	4. Priority Divergence • Challenges in Aligning Communication
5. Shared Vision and Values • Alignment of Vision and Objectives	

These variations informed the framework (Figure 1), which maps microfoundation interactions instead of 5abelling them strictly as enablers or barriers. A configuration that supports progress in one context may hinder it in another. Colour coding highlights outcomes: green for positive, yellow for mixed, red for negative, and white for no interaction. The framework captures how elements combine or clash within collaborations without fixed behavioural classifications.

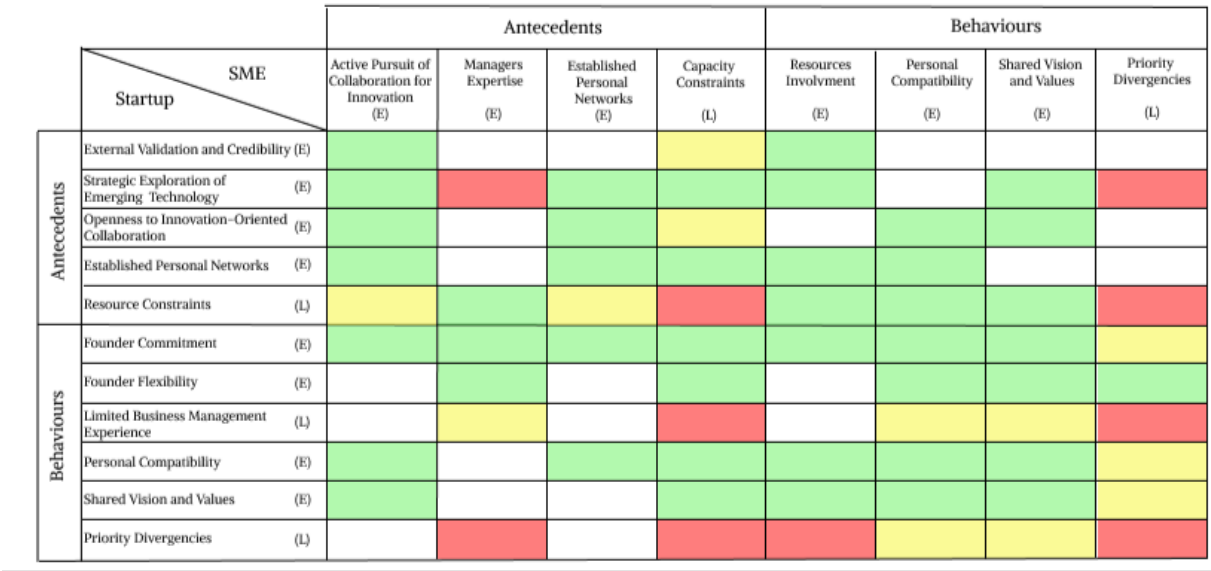


Figure 1: Microfoundations interaction framework

5. Discussion

This research examined how individual and relational microfoundations influence SME–startup collaborations, focusing on the unexplored topic of interactions (Figure 1). While previous studies highlight microfoundations in Open Innovation (Bogers et al., 2017a), the case evidence suggests these elements rarely act alone; their impact depends on interactions within the partnership. An attribute that facilitates collaboration in one context

may hinder it in another, especially when enabling microfoundations coexist with limiting ones, sometimes producing mixed or negative results. Shared vision and values were crucial for partnership stability, particularly under resource or coordination constraints. Alignment around purpose-maintained trust and advanced projects despite difficulties (Cohen & Levinthal, 1990). However, shared values alone could not prevent breakdowns when priorities diverged on timelines, investments, or expectations, often surfacing cultural distance and incompatible problem-solving approaches that reduced cohesion and increased friction (Van de Vrande et al., 2009b). Interpersonal compatibility, especially between founders and SME managers, fostered trust and eased navigation through uncertainty, mitigating the impacts of limited capacity or slow decisions (Felin & Foss, 2005). Yet, trust grounded in personal rapport was insufficient when strategic divergence emerged, straining relationships and halting aligned progress. Established networks lowered collaboration barriers; SMEs familiar with startups or introduced by trusted intermediaries faced reduced risk and quicker resource commitment (Blanka & Traunmüller, 2020). These networks functioned as informal validators, reinforcing startup credibility and mitigating limiting microfoundations such as SME capacity and startup funding constraints. External validation through funding, awards, or endorsements enhanced startup legitimacy, easing SME risk concerns and accelerating early decisions when coupled with engaged SMEs (Walker et al., 1997). Nevertheless, legitimacy alone could not prevent friction when other microfoundations opposed collaboration (Robinson & Stuart, 2007). The primary obstacle was strategic misalignment. Divergent SME and startup priorities weakened the effect of typically supportive microfoundations—trust, expertise, openness—leading to resource misallocation, weakened commitments, and tension (Chesbrough & Brunswicker, 2013). Early detection and resolution of misalignment before resource commitment emerged as vital for sustaining partnership viability.

6. Practical Implications

For SME managers, this research highlights the need for a proactive approach to external collaboration. As Ayala et al. (2017) note, partnerships with startups can effectively address internal technological gaps, but success requires more than opportunity scanning. Top management must acknowledge the strong influence of organizational culture on Open Innovation implementation. In firms lacking a collaborative mindset, even well-aligned partnerships may fail. Innovation-oriented networks and openness to external actors provide a crucial foundation for successful collaborations. Early failures often stem from mismatched expectations; thus, clearly articulating strategic goals early on is essential to align intentions and minimize breakdown risk. Trust-building also plays a subtle but critical role. Startups often need managerial guidance navigating regulatory or market complexities, and managers who offer supportive help rather than mere oversight are more successful in fostering viable joint efforts. When internal capacity is limited, recruiting individuals with complementary expertise can alleviate gaps without overwhelming existing teams. From the startup perspective, founders face distinct challenges. The findings emphasize the importance of evaluating organizational microfoundations before collaboration. This self-assessment identifies strengths and clarifies the type of partner a startup can be. Demonstrating enablers such as openness, flexibility, and long-term commitment enhances credibility, especially valued by SMEs in high-risk environments where trust and adaptability outweigh scale or experience (Low & MacMillan, 1988). However, startups must also address common weaknesses—such as weak financial planning or limited managerial experience—early, either internally or through external support, to sustain long-term partnerships. At the policy level, the research underscores the need for more human-centered support structures. Targeted training on collaboration and communication, along with mentorship programs that support both startups and SMEs, emerged as effective practices that significantly enhance conditions for sustained Open Innovation.

7. Conclusions

This study explores the microfoundations crucial to Open Innovation (OI) collaborations between SMEs and startups in Italy, addressing a gap in the literature that predominantly examines OI in large corporations rather than smaller business partnerships. By analyzing seven OI projects, the research identifies both enabling and limiting factors influencing collaboration outcomes through two primary frameworks. The first framework, adapted from Barrett and Tsekouras (2022), categorizes microfoundations into six types: Startup antecedent, Startup behaviour, SME antecedent, SME behaviour, Joint Action antecedents, and Joint Action behaviours. The second framework innovatively examines how interactions among these microfoundations generate different results depending on context, illustrating that factors typically seen as enabling may yield mixed or negative effects when combined with others. Findings highlight that effective collaboration is strongly supported by microfoundations such as shared vision, personal compatibility, and mutual adaptability. Goal alignment fosters

trust and smooth project coordination, enabling SMEs to leverage startups' flexibility and innovative insights. Additionally, established networks and access to venture capital enhance startups' credibility and resource base. Conversely, the study identifies critical barriers including divergent priorities, cultural mismatches, and resource limitations. Early resolution of these challenges in partnership agreements is essential to mitigate conflicts and create a balanced, supportive environment conducive to innovation. The study acknowledges limitations related to its geographic focus on Italy and sector specificity. It suggests that future research could broaden these boundaries through cross-country comparisons and sector-specific analyses, which may uncover distinct challenges and strengths particular to different industries.

Ethical and AI Declaration

No ethical clearance was required.

AI tools were used for copy editing and proofreading

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Flexibility's Price: Are Workers in the Gig Economy Thriving or Just Surviving?

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Abstract: The gig economy has reshaped traditional labor markets, offering new earning opportunities—but at what cost? This study examines the financial realities and job quality of gig workers operating through digital platforms in the Metropolitan Area of Lima, Peru, focusing on drivers and couriers employed by the region's most widely used ride-hailing and food delivery apps. Drawing from survey data collected from over 400 gig workers, this research evaluates their income stability, working conditions, and access to essential digital tools. The findings reveal a double-edged sword: while gig work provides quick access to income and a degree of autonomy, it is also characterized by precarious employment conditions, including unpredictable earnings, job insecurity, and the absence of critical benefits such as health insurance, paid leave, and retirement plans. Many workers rely on multiple platforms to piece together a livable income, highlighting the instability of gig-based employment. Moreover, despite their reliance on digital tools, many workers face technological barriers such as limited training, outdated devices, and inconsistent internet access, further complicating their ability to compete in this evolving labor market. This study also highlights workers' growing dependence on the very digital platforms that mediate and control their work, raising questions about who truly benefits—those striving to earn a living or the platforms profiting from their labor. This dynamic underscores a power imbalance, where risks are shouldered by workers while rewards flow to platform operators. Additionally, the study explores the challenges faced by regulators in adapting labor protections to a rapidly evolving digital workforce. By shedding light on these pressing issues, this research contributes to the global debate on the sustainability of gig work. It urges policymakers, platform operators, and other stakeholders to develop stronger labor protections, fairer wages, and improved working conditions, fostering a more equitable and sustainable economic model for the future.

Keywords: Gig Economy, Platform Work, Income Stability, Job Quality, Digital Inclusion

1. Introduction

Over the past decade, the rise of the gig economy has drawn increasing attention as a potential paradigm shift in how labor is structured and services are delivered. This model, rooted in peer-to-peer exchanges mediated by digital platforms, has disrupted multiple sectors by redefining how goods and services are accessed, offered, and monetized (Ebirim et al., 2024). At its core, the gig economy has introduced new labor dynamics that challenge traditional employer-employee relationships and call for both innovative frameworks to analyze its broader societal impact and modernized regulatory approaches to address its consequences.

Beyond academic interest, major international organizations have also weighed in on the gig economy's potential and risks. The International Labour Organization (ILO) recognized platform-mediated gig work as a key component in achieving the United Nations Sustainable Development Goals. It highlighted their potential to lift millions out of poverty by providing flexible income-generating opportunities. However, it also emphasized the challenges these platforms pose in ensuring fundamental rights, collective representation, fair wages, and social protections (ILO, 2020).

Across developed and developing nations alike, gig work has reshaped employment patterns. Sectors such as transportation and food delivery now rely heavily on app-mediated, on-demand labor. Evidence suggests that digital infrastructure and literacy are positively associated with GDP growth and lower unemployment rates (Sandri et al., 2022), sparking optimism that the gig economy may serve as a tool for labor inclusion, particularly in urban areas.

2. Literature Review

2.1 Defining the Gig Economy in Relation to the Sharing Economy

Although often used interchangeably in public discourse, the terms *sharing economy* and *gig economy* refer to overlapping yet distinct models of digitally mediated activity. Both rely on digital platforms and promote flexible arrangements, but they differ fundamentally in their mechanisms and participants. The sharing economy centers on peer-to-peer access to underused assets, such as homes or cars, while the gig economy is characterized by

short-term, task-based labor typically performed by independent contractors (Kaine & Josserand, 2019; Li et al., 2021).

Table 1: Key Differences Between the Sharing and Gig Economies

Feature	Sharing Economy	Gig Work
Core Activity	Sharing of Assets	Selling of labor / time
Participants	Asset owners and users	Workers and clients
Platform Role	Matches owners with users	Matches workers with gigs
Income Source	Renting / sharing an asset	Performing a task / service
Examples	Airbnb, Turo	Cabify, InDrive, Pedidos Ya, Rappi

While some platforms—such as Cabify or Rappi—incorporate elements of both models by requiring workers to use personal assets, the nature of the work remains fundamentally gig-based.

2.2 Access and Entry Barriers

App-based gig work has created new income opportunities, often accessible to individuals excluded from traditional labor markets (Huang et al., 2020). However, it introduces its own set of barriers. These include the need for capital (e.g., owning a vehicle or smartphone), digital literacy, and platform-specific requirements (Burger & Fourie, 2019). While often marketed as accessible, such work still filters out individuals lacking these resources.

Additionally, structural drivers of unemployment—such as job market exclusion, urgency for income, and lack of alternatives—push many into platform work. For some, it is a choice; for others, a necessity born of economic precarity (MTPE, 2023; Clark & Lepinteur, 2019).

2.3 Digital Inclusion and Narrowing the Divide

The digital divide remains a key obstacle in many developing nations, where access to reliable devices, internet, and digital literacy is uneven (Rosário & Dias, 2023). Yet gig work can offer a bridge, connecting people to digital tools and enabling participation in the digital era.

Key elements of this inclusion include access to devices and networks (Prianto et al., 2021), training to use platform tools effectively (Waldkirch et al., 2021), and the demographic dimension: individuals from low-income or rural areas who often benefit the most from these opportunities—but are also at highest risk of exclusion (Sanchez-Prieto et al., 2020).

2.4 Regional Views on the Gig Economy in Latin America

Latin America has seen a rapid rise in gig work, with Colombia standing out as the origin of Rappi—one of the region's most prominent app-based gig services—and thus one of the most studied cases (Fernández & Benavides, 2020; Salinas et al., 2022). Neighboring countries such as Chile and Ecuador have also drawn scholarly attention due to their geographic and socioeconomic proximity, showing similar gig work patterns. In Colombia, large-scale surveys of Rappi workers revealed mixed outcomes: income flexibility on one hand, but legal ambiguity and lack of protections on the other (Fernández & Benavides, 2020). In Chile, interview-based studies have emphasized similar concerns, calling for minimum labor standards and better communication between workers and platforms (Arriagada et al., 2023).

In Ecuador and Chile, workers report algorithm-driven schedules, long hours, and weak protections for health, income, and labor rights (Albornoz & Chavez, 2024; Arriagada et al., 2023). These trends reveal a regional challenge: balancing opportunity with protections. Portuguese-language studies from Brazil were excluded from this review due to language constraints, and limited data availability restricted the inclusion of Bolivian cases.

2.5 The Peruvian Context

In Peru, two key organizations have emerged in response to the evolving gig economy landscape: the Observatorio de Plataformas Digitales (OPD), a research-focused institution dedicated to analyzing labor transformations within platform-based gig work, and the Sindicato de Trabajadores de Plataformas Digitales

(SINTRAPLADI), a labor union representing app-based gig workers. Reports from OPD and Fairwork (2023) reveal that while gig platforms offer flexibility and income, most fail to meet fair work standards.

Fairwork scores Peruvian platforms on principles like pay, contracts, and representation, with most platforms receiving low ratings. Meanwhile, national studies from the Instituto Peruano de Economía (IPE, 2023), a prominent Peruvian economic research institute, estimate that over 130,000 individuals worked in app-based gig roles in 2022. Most have completed secondary or technical education, and their motivations range from income supplementation to flexible scheduling. The IPE notes that gig work has contributed to lowering unemployment and expanding income-generating options.

2.6 Diverging Perspectives

Supporters of the gig economy argue that it fosters innovation, creates jobs, and accommodates diverse work schedules (Flores et al., 2020; Borys et al., 2021). They also emphasize company-led digital training initiatives that build worker capacity.

Conversely, critics point to precarity, lack of labor rights, and weak regulatory frameworks (de Andrés et al., 2024; García et al., 2021). Gig workers are often excluded from legal definitions of employment, which limits access to benefits and protections. Studies also highlight the influence of political and legal ambiguity in shaping labor outcomes across platform sectors.

2.7 Research Gap and Purpose

Despite growing scholarship on the gig economy, there remains a notable lack of integrated research examining both its impact on employment generation and digital inclusion, particularly in the Peruvian context. Most studies focus on these aspects separately, failing to explore how participation in gig work influences both economic and technological integration for workers. This gap is especially significant in Lima, where ride-hailing and delivery platforms have become widespread sources of income, yet workers continue to face labor precarity, income instability, and barriers to digital access.

Existing research has also tended to emphasize either macroeconomic outcomes or regulatory challenges, without directly engaging with workers lived experiences or evaluating how the structure of platform labor affects financial realities, access to digital tools, and autonomy in daily work. As platforms expand rapidly across Lima's urban landscape, a comprehensive understanding of how workers perceive the trade-offs between flexibility and precarity remains limited.

This study responds to that gap by collecting and analyzing worker-reported data from a broad sample of gig workers in Lima. It focuses on understanding their financial stability, job quality, and digital inclusion through a structured and multidimensional approach. By emphasizing the worker perspective, this research contributes to the growing body of international literature on the gig economy, while offering grounded insights that can inform future policy and platform accountability in Peru.

3. Methodological Framework

3.1 Research Design and Approach

The methodology applied in this study follows a non-experimental, cross-sectional, and correlational design, used to analyze the gig economy's impact on employment and the digital divide in Lima. This approach was selected because the variables were not manipulated, but rather observed at a single point in time, allowing for the identification of potential associations between the independent variable—participation in digitally mediated gig labor—and the dependent variables—employment access and digital inclusion.

3.2 Population, Sampling, and Data Collection

The unit of analysis for this study consists of workers participating in the gig economy, specifically those employed by food delivery and ride-hailing platforms. Based on estimates from Fairwork (2023) and the Instituto Peruano de Economía (IPE, 2023), approximately 133,000 individuals are engaged in app-based gig work across Peru, with around 81% located in Lima. This proportion yields an estimated population of 107,730 platform workers in the Metropolitan Lima area.

To ensure statistical representativeness, a simple random sampling method was applied. Using a 95% confidence level and a 5% margin of error, a minimum sample size of 383 respondents was determined. Ultimately, 417 valid responses were collected through structured surveys, exceeding the required threshold and strengthening the robustness of the data.

3.3 Survey Instrument and Dimensions

The primary data collection technique employed in this study was a structured survey, designed to gather essential information regarding workers' experiences in the gig economy. The instrument aimed to assess not only labor conditions, but also access to digital technologies and perceptions of employability—aligning directly with the study's core research objectives.

To ensure quantitative consistency and enable statistical analysis, the survey consisted exclusively of closed-ended questions. The questionnaire was divided into two main sections:

Sociodemographic and Work Profile: This section captured foundational information such as gender, age, education level, district of residence, hours worked per week, platform type, duration of engagement in platform work, and monthly income bracket.

Perceptions of Gig Work: This section included Likert-scale items rated from 1 (Strongly Disagree) to 5 (Strongly Agree). These items were organized across five analytical dimensions:

- Financial Reality
- Job Quality
- Income Stability
- Autonomy
- Access to Digital Tools

These dimensions were conceptually developed to evaluate both economic outcomes and digital inclusion from the perspective of workers. By structuring the survey in this way, the instrument facilitates descriptive, correlational, and comparative analysis across key indicators of gig-based labor in Lima.

3.4 Reliability Testing (Cronbach's Alpha)

To assess the internal consistency of the survey instrument, Cronbach's Alpha was calculated for the composite dimensions derived from the Likert-scale items. The resulting coefficient was 0.68, slightly below the 0.70 benchmark. However, this value is generally considered acceptable in exploratory research within the social sciences—particularly when measuring perception-based constructs.

Although there is room for improvement in future iterations of the instrument, the obtained alpha score indicates that the items within each dimension exhibit a sufficient degree of interrelatedness and capture the intended conceptual themes. As such, the reliability level is deemed adequate to support the study's analytical framework and interpretation of results.

3.5 Normality Testing (Shapiro-Wilk)

To assess the distribution characteristics of the composite dimensions, the Shapiro-Wilk test was applied to each of the five key constructs: Financial Reality, Job Quality, Income Stability, Autonomy, and Access to Digital Tools. In all cases, p-values were below 0.001, indicating statistically significant deviations from a normal distribution.

The test results were further supported by skewness values: Financial Reality (0.733) and Income Stability (1.733) showed positive skewness, while Job Quality (−1.044), Access to Digital Tools (−0.615), and Autonomy (−1.045) exhibited negative skewness. These findings, in combination with the ordinal nature of the Likert-scale items, justified the use of non-parametric statistical methods in the subsequent correlational and comparative analyses.

Table 2: Normality Test Results and Skewness of Composite Dimensions

Dimension	Shapiro-Wilk	p-value	Skewness
Financial Reality	0.888	< 0.001	0.733
Job Quality	0.846	< 0.001	-1.044

Dimension	Shapiro-Wilk	p-value	Skewness
Access to digital tools	0.903	< 0.001	-0.615
Income stability	0.894	< 0.001	1.733
Autonomy	0.815	< 0.001	-1.045

3.6 Correlational Tests (Spearman) and Comparative Analysis (ANOVA)

To examine the relationships between key variables and test the proposed hypotheses, a combination of correlational and comparative statistical techniques was employed.

Spearman's rank correlation coefficient was applied to evaluate the strength and direction of associations among the main constructs—Financial Reality, Job Quality, Access to Digital Tools, Income Stability, and Autonomy. This method was chosen due to both the ordinal nature of the Likert-scale data and the non-normal distribution confirmed by previous normality testing. Results revealed statistically significant correlations, particularly between Financial Reality and Job Quality, and between Financial Reality and Access to Digital Tools, supporting the notion of interrelated dimensions in the experience of platform workers.

To complement the correlational analysis, Chi-square tests of independence were used to assess the association between categorical variables. Notably, the relationship between Financial Reality and Job Quality yielded a p-value < 0.001 and a Cramer's V of 0.455, indicating a moderate to strong association. Significant associations were also found between Income Stability and Job Quality, as well as between Financial Reality and Access to Digital Tools.

Table 3: Chi-Square Associations Between Key Dimensions

Test	Financial Reality & Job Quality	Financial Reality & Access to digital tools	Income Stability & Job Quality
Chi-square	172.87	-	-
Cramer's V	0.455	> 0.455	> 0.455
p-value	< 0.001	< 0.001	-0.615

For group comparisons, One-way ANOVA was conducted to determine whether the degree of participation in the gig economy had a significant effect on each of the five main dimensions. While the data were not normally distributed, the large sample size allowed the use of ANOVA under the assumptions of the Central Limit Theorem. The results were compelling—statistically significant differences were observed across all dimensions, with F-statistics ranging from 64.218 to 79.219 and p-values < 0.001, suggesting that participation in app-based gig work considerably influences workers' perceptions and experiences.

Table 4: ANOVA Results for Dimensions

Variable	F-statistic	p-value	Interpretation
Financial Reality	64.218	< 0.001	Significant effect of gig economy
Job Quality	79.219	< 0.001	Significant effect of gig economy
Access to digital tools	66.734	< 0.001	Significant effect of gig economy
Income stability	71.512	< 0.001	Significant effect of gig economy
Autonomy	68.947	< 0.001	Significant effect of gig economy

These analyses underscored the pivotal role of Financial Reality as the most influential construct, while also confirming the broader impact of gig-based work on job quality, digital inclusion, income stability, and perceived autonomy in Lima's urban labor market.

3.7 Tools and Software Used (Excel, JASP)

Two main tools were used for data processing and statistical analysis:

- Microsoft Excel supported the initial stages of the workflow, including data cleaning, organization, and the calculation of descriptive statistics such as frequencies, means, and standard deviations.

- JASP, an open-source and user-friendly statistical software, was used to conduct all inferential analyses. This included the Shapiro-Wilk test, Cronbach's Alpha, Spearman correlations and ANOVA tests, as well as the generation of correlation matrices and heatmap visualizations.

4. Results

4.1 Descriptive Profile of Gig Workers in Lima

The majority of respondents identified as male (91.8%), with the largest age group being 25 to 34 years old (39.2%). Educational attainment was relatively low, with 57.9% having completed only secondary education. In terms of residential location, 33.2% lived in Zone 2 districts such as Independencia, Los Olivos, and San Martín de Porres—areas commonly associated with lower-middle socioeconomic status.

Most participants were engaged in food delivery services (76.2%), with only a minority working in ride-hailing. Nearly half of the respondents (49.8%) reported working between 41 and 50 hours per week, aligning closely with Peru's national average of 48 hours. Additionally, 38.7% had been working on platforms for 1 to 2 years, suggesting an emerging trend toward medium-term platform engagement.

In terms of income, the most commonly reported monthly range was between S/. 1026 and S/. 1500 (44.5%), which—at the time of the study—was roughly equivalent to $277 to $405 USD, based on an exchange rate of 3.7 nuevos soles per dollar. This bracket hovers around the minimum wage at the time (S/. 1025 ≈ $277 USD), indicating that while platform work provides income opportunities, earnings remain precariously close to subsistence levels for many.

Table 5: Summary of Worker Demographics and Platform Use

Variable	Most Common Category	Percentage
Gender	Male	91.8%
Age Range	25 - 34 years old	39.2%
Education	Secondary education	57.9%
Residence (Zone)	Zone 2 (e.g., Independencia, Los Olivos, SMP)	33.2%
Platform Type	Food Delivery	76.2%
Weekly Hours Worked	41-50 hours	49.8%
Time on Platform	1-2 years	38.7%
Monthly Income	S/. 1026 – S/. 1500	44.5%

This descriptive profile highlights a labor force that is predominantly young, male, and operating within socioeconomically constrained environments.

4.2 Index-Based Analysis of Gig Work Realities

To evaluate the perceived impact of the gig economy, five composite indices were constructed: Financial Reality, Job Quality, Access to Digital Tools, Income Stability, and Autonomy. Each index was calculated by averaging multiple Likert-scale items (ranging from 1 = Strongly Disagree to 5 = Strongly Agree), based on responses from 417 participants.

Table 6: Composite Index Ratings by Dimension

Dimension	Mean Score	Interpretation
Financial Reality	2.89	Moderate financial strain, inconsistent earnings reports
Job Quality	2.56	Low job satisfaction; lack of benefits and labor protections
Access to Digital Tools	3.12	Basic access present; limitations in training and device quality persist
Income Stability	2.44	High income variability; multiple platforms to meet financial needs
Autonomy	3.41	Perceived flexibility in schedule and platform selection

The results reveal a clear contrast: Autonomy scored highest, reflecting a sense of flexibility that workers value in gig-based jobs. However, dimensions such as Income Stability (2.44) and Job Quality (2.56) received the lowest average scores, highlighting worker concerns about volatile earnings, lack of protections, and general precarity.

Interestingly, while Access to Digital Tools (3.12) scored slightly above the midpoint, it still reveals gaps in digital inclusion—particularly around device quality and training. Financial Reality, with a mean of 2.89, further illustrates that although gig work provides some income, it does not necessarily translate into financial security or economic well-being.

Altogether, these findings reinforce the notion that app-based gig work offers flexibility at the expense of stability, with financial precarity emerging as the most pressing issue among workers.

4.3 Correlational Analysis and Heatmap

To explore how the five key dimensions interact, a Spearman's rank correlation analysis was conducted. This method was selected due to the ordinal scale of the data and the previously established non-normal distribution of the composite indices.

The results revealed several strong and statistically significant associations, particularly between Financial Reality and Job Quality ($\rho = 0.61$), and Financial Reality and Access to Digital Tools ($\rho = 0.55$). These correlations suggest that respondents experiencing greater financial strain were also more likely to report poor working conditions and limited access to digital resources.

Income Stability showed moderate positive correlations with both Job Quality and Access to Digital Tools, indicating that workers with more consistent earnings tend to have better experiences across multiple dimensions of platform work. In contrast, Autonomy exhibited weaker correlations with the other variables, suggesting that perceptions of flexibility may function independently from economic or technological constraints.

These relationships are visually represented in Figure 1, a correlation heatmap that highlights the interconnectivity—and occasional divergence—between workers' experiences across the platform labor spectrum.

Dimension	Financial Reality	Job Quality	Access to Digital Tools	Income Stability	Autonomy
Financial Reality	1.00	**0.61**	**0.55**	0.47	0.30
Job Quality	**0.61**	1.00	0.50	**0.59**	0.33
Access to Digital Tools	**0.55**	0.50	1.00	0.44	0.29
Income Stability	0.47	**0.59**	0.44	1.00	0.35
Autonomy	0.30	0.33	0.29	0.35	1.00

Figure 1: Spearman Correlation Heatmap of Gig Work Dimension

5. Discussion

5.1 Interpretation of Key Findings

The findings of this study paint a nuanced picture of gig-based labor in Lima, revealing a clear trade-off between flexibility and economic security. While Autonomy emerged as the most positively rated dimension, reflecting workers' appreciation for self-managed schedules and platform choice, other indicators revealed significant structural challenges. Notably, Income Stability and Job Quality were consistently rated the lowest, suggesting that flexibility often comes at the expense of predictability and protection.

The strong correlation between Financial Reality and both Job Quality and Access to Digital Tools indicates that economic strain is not experienced in isolation. Instead, it is intertwined with broader barriers, including precarious working conditions, insufficient digital infrastructure, and limited support systems. These interdependencies align with previous research suggesting that gig economy platforms tend to externalize risks while absorbing the rewards (de Andrés et al., 2024; ILO, 2020).

Interestingly, while Access to Digital Tools scored moderately, the data suggest that even basic levels of access do not necessarily translate into competitive digital inclusion. Gaps in training, outdated devices, and limited internet access continue to affect how workers engage with platform algorithms and optimize their income

streams—echoing the growing concern that digital infrastructure alone is not enough without active upskilling and support (Waldkirch et al., 2021).

The overall picture reflects what many have described as a "double-edged sword" dynamic in the gig economy: it creates rapid access to income-generating activities, but under conditions that often reproduce or even amplify existing socioeconomic vulnerabilities. For many respondents, gig work is not a stepping stone to upward mobility, but a survival strategy in the absence of better options.

5.2 How Gig Work Shapes Economic Realities

The data clearly show that gig work offers income opportunities, but rarely delivers economic security. Most respondents reported earnings near or just above the minimum wage, and Income Stability received the lowest average rating among all dimensions. This aligns with broader critiques of gig economy models, where earnings fluctuate daily, and workers bear the brunt of market demand, app algorithm changes, and platform fees.

Moreover, the high rate of multiplatform use and long working hours—often beyond the legal average—suggests that workers are patching together income rather than building sustainable livelihoods. Financial stress is compounded by the lack of social protections, such as health insurance, paid leave, or retirement plans—reinforcing a model where workers remain economically vulnerable despite being constantly active.

Ultimately, the gig economy in Lima appears to offer access to work, but not necessarily access to economic mobility. It reshapes labor around flexibility, but does so while offloading risk onto workers, many of whom operate within already fragile socioeconomic conditions.

5.3 The Tension Between Flexibility and Precarity

The data reflects a core paradox of gig work: while workers value the flexibility and autonomy it offers, these benefits coexist with economic precarity. The high score in Autonomy contrasts sharply with low ratings in Job Quality and Income Stability, underscoring that freedom in scheduling does not equate to security or dignity. This tension suggests that flexibility, while real, may act more as a coping mechanism than a real choice.

5.4 Policy Implications and the Role of Regulation

Findings point to an urgent need for regulatory frameworks that recognize and protect platform workers. Current conditions fall short of fair labor standards, with low formalization, weak protections, and limited avenues for worker voice. Entities like SINTRAPLADI and global tools like Fairwork ratings offer early steps toward accountability, but systemic change will require state intervention, clearer classification of labor relationships, and enforcement of minimum protections, regardless of employment status.

6. Conclusion

6.1 Summary of Core Insights

This study offers a multidimensional view of gig work in Lima, revealing a labor force that values autonomy but faces significant financial and structural challenges. While digital platforms and apps provide access to income and flexible schedules, they fall short in delivering job stability, protections, and financial well-being. Key dimensions such as Income Stability and Job Quality were consistently rated low, reinforcing concerns about the precarious nature of platform-based employment.

6.2 Contributions to Ongoing Global Debate

These findings contribute to a growing global dialogue on the real costs of gig work, particularly in developing urban economies. By centering worker experiences and using a grounded, data-driven approach, this research strengthens calls for a more balanced and equitable gig economy—one that doesn't trade protection for flexibility.

6.3 Recommendations for Policymakers and Future Research

Policymakers should regulate gig-based labor by setting minimum standards for pay, conditions, and digital access. Partnerships with groups like SINTRAPLADI and global frameworks such as Fairwork can guide this. Future

research should explore gender, formality, algorithmic control, and AI's impact on labor through longitudinal and comparative analysis.

Ethics Declaration

Ethical clearance was not required for the research.

AI Use Statement

No AI tools were used in the writing of this paper.

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The Role of Digital Technologies and AI on the Development of Entrepreneurial Mindset in First-Year University Students

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Abstract: In the context of an increasingly digitalized world, entrepreneurship education must adapt to new technological paradigms to effectively prepare students for future challenges. Digital technologies and artificial intelligence (AI) are transforming the ways in which first-year university students engage with entrepreneurial learning, influencing their mindset, creativity, and problem-solving abilities. This study explores the extent to which AI-driven tools, digital platforms, and online collaborative environments contribute to the early development of an entrepreneurial mindset among first-year students in higher education. Through questionnaire surveys, this research investigates how students interact with digital learning resources, including AI-driven business simulations, virtual mentorship programs, and automated feedback systems. The study seeks to analyze whether these technologies enhance students' ability to identify opportunities, develop resilience, and think innovatively, key characteristics of successful entrepreneurs. Additionally, the research assesses potential barriers, such as gaps in digital literacy, resistance to AI adoption, and ethical concerns related to data privacy and bias in AI-generated recommendations. The results of this study will provide valuable insights into the role of AI and digitalization in the development of students' entrepreneurial skills, both in terms of pedagogical outcomes, such as the ability to deliver presentations, work in teams, or solve case studies, and in fostering creative and innovative ideas with the potential for business creation. Ultimately, this study contributes to the ongoing debate on the role of AI and digitalization in transforming entrepreneurship education. By understanding the impact of these technologies on first-year students, we can develop more effective learning strategies that not only enhance entrepreneurial thinking but also empower students to become problem solvers and innovators in an ever-changing global market.

Keywords: Entrepreneurship; AI; Higher Education; Entrepreneurial Mindset.

1. Introduction

The development of an entrepreneurial mindset in first-year university students is increasingly influenced by the integration of digital technologies and artificial intelligence (AI) into educational environments. As higher education adapts to the demands of a digital economy, the role of these technologies in shaping entrepreneurial thinking, creativity, and opportunity recognition has become a central focus of academic inquiry.

Lynch and Corbett (2023) emphasize that the entrepreneurial mindset is not static but evolves through cycles of learning that involve both ideation and execution. They argue that digital tools can support this duality by offering iterative, feedback-rich environments that mirror real-world entrepreneurial challenges.

This aligns with the pedagogical shift toward experiential learning, where AI-driven simulations and virtual mentorship platforms provide students with opportunities to test ideas, fail safely, and refine their approaches.

Hasan et al. (2024) further highlight the importance of digital business literacy in fostering entrepreneurial readiness among Generation Z students. Their study shows that digital competencies, including familiarity with AI tools, significantly enhance students' ability to engage with entrepreneurial education. They argue that digital literacy acts as a mediator between educational content and entrepreneurial outcomes, reinforcing the need to embed these skills early in university curricula.

Moreover, the adoption of AI in educational settings is not without challenges. Ethical concerns, such as algorithmic bias and data privacy, are increasingly scrutinized. Pratschke (2024) warns that while AI can personalize learning and support creativity, it must be implemented with transparency and critical oversight to avoid reinforcing inequalities or limiting student agency.

The literature also suggests that AI can serve as a cognitive partner in the learning process. Bell and Bell (2023) propose that generative AI tools, when used responsibly, can stimulate entrepreneurial thinking by offering

diverse perspectives, automating routine tasks, and enabling rapid prototyping of business ideas.

These capabilities are particularly valuable for first-year students, who may lack confidence or experience in entrepreneurial contexts.

The integration of digital technologies and AI into entrepreneurship education is reshaping how first-year university students develop entrepreneurial mindsets. These tools not only enhance pedagogical outcomes—such as collaboration, presentation skills, and problem-solving—but also foster the resilience and creativity needed to navigate an uncertain global economy. However, successful implementation requires addressing digital literacy gaps and ethical concerns to ensure equitable and effective learning experiences.

By examining these concerns, the study provides a balanced view of AI's role in shaping entrepreneurial education while ensuring ethical considerations.

2. Methodology

This study employed a quantitative research approach through a structured survey administered to first-year students enrolled in short-cycle professional higher education courses at Polytechnic University of Cávado and Ave, Portugal. These short-cycle programs last two years (3 academic semesters and 1 semester of practical training in a work context) and are designed to provide practical and vocational education aligned with labour market needs.

The questionnaire was developed through an internal collaborative process among faculty members involved in entrepreneurship education. Its design was also informed by relevant literature on digital literacy and entrepreneurial skills (e.g., Hasan et al., 2024; Lynch & Corbett, 2023). The survey aimed to explore students' experiences, behaviors, and perceptions regarding the use of artificial intelligence and digital technologies within the academic setting.

A pilot version of the survey was tested with a small group of students (n = 10) to ensure clarity and relevance. Items were then refined based on feedback. The final version included both closed-ended and Likert-scale questions. Inclusion criteria for questions were based on their alignment with the study's objectives, clarity of language, and ability to yield actionable insights into entrepreneurial mindset development. Questions not directly related to these constructs or found ambiguous during the pilot were excluded.

This analysis focused on a sample of 124 higher education students, mostly from Management courses (56,6%), followed by Technology (11,5%), Design (8,2%) and other areas (23,8%). The respondents were 57% female and 43% male, ensuring a balanced gender representation.

The survey consisted of both closed-ended and Likert-scale questions, designed to explore students' experiences and perceptions regarding artificial intelligence and digital technologies in the context of entrepreneurship education.

The objective of the survey was to gather data on how students engage with AI and digital technologies in their academic journey and to assess the extent to which these tools contribute to the early development of entrepreneurial thinking and behavior. The results aim to inform people about the design of more effective and ethically aware entrepreneurship education practices in digitally enhanced learning environments.

3. Results

The findings of the questionnaire reveal a mixed but insightful picture of the entrepreneurial mindset among first-year students enrolled in short-cycle professional higher education programs.

Although students recognize the value of digital tools and AI technologies in enhancing their personal and academic skills, a strong entrepreneurial intent is not yet widespread. In fact, with regard to entrepreneurial intentions, 20,3% of those surveyed said they wanted to set up their own business, and 47,2% said they would consider doing so in the future.

The frequency of use of digital tools and online platforms proved to be high, with 93% of students indicating daily or weekly use (Table 1). This intensity of use demonstrates a strong integration of these technologies into students' daily academic and personal lives.

Table 1: Frequency of usage of digital tools

Question: How frequently do you use digital tools or online platforms?	Answers	%
Daily	85	69%
Weekly	30	24%
Monthly	7	6%
Rarely/Never	2	2%

As for the purposes of use, Table 2 illustrates the primary purposes for which students use digital tools and online platforms in their academic and personal routines. The data reveal that the majority of respondents employ these tools for academic tasks, with 31% using them primarily for writing university assignments and 26% for collaborative teamwork with classmates. Additionally, 30% reported using digital tools for personal purposes, indicating a high level of digital engagement beyond academic contexts. However, only 9% of students reported using these tools for entrepreneurship-related activities, which suggests that this aspect, although present, is not yet central to students' digital practice.

Table 2: Purpose of the use of digital tools

Options	Answers	%
Team work with university mates	80	26%
Paper works for university	95	31%
Personal subjects	90	30%
Entrepreneurship activities	26	9%
Other	13	4%

Ethical concerns regarding AI usage emerged as a significant issue. When asked whether they had ever avoided using AI tools due to ethical concerns (e.g., related to personal data use or bias), 55% of respondents answered "yes," indicating a cautious stance toward AI integration in academic contexts (Table 3).

Table 3: Ethical concerns

Question: Have you ever avoided using an AI tool due to ethical concerns (e.g., use of personal data)?		
Options	Answers	%
Yes	68	55%
No	56	45

Despite these concerns, students acknowledged that digital technologies positively contribute to the development of soft skills critical to an entrepreneurial mindset. As shown in Table 4, 93% of respondents stated that digital tools have improved their ability to work in teams remotely, 91% reported improvements in their capacity to present ideas clearly, and 96% affirmed that digital tools enhanced their ability to analyze complex case studies.

Table 4: Impact of Digital Technologies on Key Soft skills

Question	Yes	No	% Affirmative answers
Have digital technologies improved your ability to work in teams remotely?	115	8	93%
Have digital technologies improved your ability to present ideas clearly (e.g., in a pitch)?	112	11	91%
Have digital technologies improved your ability to analyze complex case studies?	117	5	96%

Students' perceptions of the impact of digital technologies and artificial intelligence (AI) on their skills are generally very positive (Table 5). The majority recognized improvements in remote teamwork skills (93,5%), in the presentation of ideas (91,1%) and in the analysis of complex case studies (95,9%). In addition, 79,7% said that digital or AI tools are used in their courses, and 60,2% have used AI to validate a business idea. Although participation in simulations of entrepreneurial challenges is more limited (36,9%), the data indicates a growing involvement with this type of tool.

Table 5: Perception of AI impact on entrepreneurial skills

Question	Affirmative answers
Have digital technologies improved the ability to work remotely?	93,50%
Have they improved the ability to present ideas?	91,10%
Improved ability to analyse complex cases?	95,90%
Are digital tools/IA used in the course?	79,70%
Did you take part in online simulated entrepreneurial activities?	36,90%
Used AI to validate a business idea?	60,20%

When asked if they felt better prepared to undertake business after using digital and AI tools during their first year at university, 62,6% answered yes, although only partially. Only 16,3% felt fully prepared, and a minority felt no effect at all (4,1%).

Perceptions of the impact of AI on soft skills were particularly positive with regard to generating innovative ideas (mean = 3,89) and solving problems (mean = 3,83) (Table 6). The perception that these tools help develop critical thinking, initiative and resilience, although positive, showed slightly lower average values.

When asked whether AI tools help them solve problems, the majority of students expressed agreement: 57% agreed and 14% totally agreed, while only 2% disagreed. Similarly, 52% agreed and 10% totally agreed that AI tools contribute to building resilience in the face of failure, although a significant portion (40%) responded neutrally, indicating room for deeper engagement in this area.

Students showed particularly strong support for the idea that AI tools help generate innovative ideas with 59% agreeing and 18% totally agreeing—making it the item with the highest positive response rate in this set. Responses to whether AI tools help develop initiative were more balanced: 43% agreed and 10% totally agreed, but 35% selected the neutral option, and 10% expressed disagreement, suggesting mixed perceptions about AI's role in fostering proactive behaviors.

Finally, in regard to critical thinking 40% agreed and 10% totally agreed that digital tools enhance this skill, while 33% remained neutral and 15% disagreed. These results suggest that while students generally recognize the value of AI and digital tools in supporting innovation and problem-solving, the perceived impact on resilience, initiative, and critical thinking is less definitive and may require targeted pedagogical strategies to strengthen.

A 5-point Likert scale was used specifically in Table 6 to assess students' subjective perceptions of how AI and digital tools contribute to soft skill development—such as resilience, critical thinking, and initiative. These constructs are inherently personal and attitudinal, and therefore more suitably captured through scaled responses rather than binary yes/no options.

In addition to mean values and standard deviations, percentage breakdowns of responses (e.g., percentage of students who agreed or strongly agreed) are provided to enhance interpretability and support comparison across skill areas.

Table 6: Perceptions of the impact of AI on soft skills

Question	Mean	Std. Deviation
AI helps solve problems	3,83	0,712
AI helps develop resilience in the face of failure	3,56	0,793
AI helps generate innovative ideas	3,89	0,780

Question	Mean	Std. Deviation
AI helps develop initiative	3,51	0,911
The use of digital tools enhances critical thinking	3,42	0,969

The statistical analysis yielded compelling evidence of significant associations between key variables. Notably, the frequency of digital tool usage was positively correlated with students' perceptions of their ability to work remotely (p = 0,030) and to analyse complex cases (p = 0,001), indicating that more frequent use aligns with more favourable self-assessments in these domains. Furthermore, students enrolled in courses that incorporate AI tools reported significantly higher levels of agreement with the notion that such tools foster the development of initiative (p = 0,009), underscoring the perceived educational value of AI integration.

Participation in online activities that simulate real entrepreneurial challenges is significantly related to remote working capacity (p=0,026), with participation being associated with greater working capacity. On the other hand, those who have taken part in these types of challenges believe that they contribute significantly to increasing their critical thinking skills (p=0,012) and that they help generate innovative ideas (p=0,032).

4. Discussion

The findings of this study offer important insights into the role of artificial intelligence (AI) and digital technologies in entrepreneurship education, particularly among first-year students in short-cycle higher education programs. The results confirm that while these students are deeply engaged with digital tools in their academic and personal routines, the direct connection between such tools and the cultivation of an entrepreneurial mindset remains underdeveloped.

The high frequency of digital tool usage (with 93% of students reporting daily or weekly engagement) indicates a strong baseline of digital integration. However, this engagement appears to be primarily task-oriented—focused on academic assignments and collaborative teamwork—rather than explicitly entrepreneurial. Only 9% of students reported using digital platforms for entrepreneurship-related activities. This disconnect suggests that while digital fluency is widespread, entrepreneurial application of these tools is not yet systematically adopted in the educational experience of first-year students.

Nevertheless, students perceive clear benefits of AI and digital technologies in developing key soft skills essential to entrepreneurship. A significant majority acknowledged improvements in teamwork, presentation, and analytical skills, with percentages exceeding 90% in each category. These findings reinforce previous literature (e.g., Lynch & Corbett, 2023; Bell & Bell, 2023), which state that AI can function as a cognitive and collaborative partner, enabling students to refine complex skills through real-time feedback and simulation-based learning.

In line with Hasan et al. (2024), the results also support the notion that digital and AI tools act as enablers of entrepreneurial readiness by bridging content knowledge with applicable competencies. The use of AI to validate business ideas (reported by 60,2% of respondents) and participation in entrepreneurial simulations (36,9%) highlight the potential of such tools in experiential learning. Moreover, statistical analyses revealed meaningful associations between digital engagement and self-perceived capacities in remote work, case analysis, initiative development, and innovative thinking—skills central to entrepreneurship.

Despite these positive trends, the development of more complex attributes—such as resilience, initiative, and critical thinking—appears less robust. Students' responses regarding the impact of AI on these dimensions were more nuanced and, in some cases, ambivalent. For instance, while a majority agreed that AI helps in generating innovative ideas (mean = 3,89), fewer were confident in its role in fostering initiative (mean = 3,51) or critical thinking (mean = 3,42). These findings indicate that, although AI demonstrates considerable potential in enhancing the cognitive and collaborative facets of learning, its impact on the affective and metacognitive components of entrepreneurial mindset development may necessitate more deliberate and pedagogically grounded instructional strategies.

Additionally, ethical concerns emerged as a salient theme. Over half of the respondents (55%) indicated having avoided AI tools due to data privacy or bias concerns. This finding underscores the importance of critical digital literacy and ethical education in preparing students for responsible AI engagement. As Pratschke (2024) notes, the implementation of AI must be accompanied by transparent, inclusive, and ethically grounded frameworks to ensure equitable learning environments and prevent the marginalization of certain student groups.

Finally, the study's findings also point to an opportunity for early-stage entrepreneurship education to leverage AI not just as a support tool, but as a co-creator in the learning process.

This discussion reveals both the promise and the challenges of using AI and digital technologies to foster entrepreneurial mindsets among first-year students. While students are receptive to digital tools and recognize their academic utility, a strategic reorientation is necessary to leverage these technologies for entrepreneurial development. Future research and practice should prioritize bridging the gap between digital engagement and entrepreneurial application through ethically grounded, experiential, and integrated teaching strategies.

5. Conclusion

This study contributes to a growing body of research on the transformative role of artificial intelligence (AI) and digital technologies in entrepreneurship education. By focusing on first-year students enrolled in short-cycle higher education programs, the research has offered valuable insights into how digital tools influence the early development of entrepreneurial skills and mindset.

The results confirm that AI and digital platforms play a supportive role in enhancing pedagogical outcomes, such as improving students' ability to deliver presentations, collaborate in teams, and analyze complex case studies. Moreover, students perceive AI tools as facilitators of creativity and innovation—two fundamental dimensions of entrepreneurial capacity. A majority recognized that digital technologies help them solve problems and generate new ideas, which are essential for business ideation and opportunity recognition.

However, despite high levels of digital engagement, the specific application of these tools to entrepreneurship remains relatively underdeveloped. For instance, while most students use AI and digital resources regularly in academic contexts, only a small proportion reported using them directly for entrepreneurial initiatives. Additionally, ethical concerns about data privacy and AI bias emerged as significant barriers to more extensive use, suggesting the need for more transparent and responsible implementation.

These findings reinforce the necessity of designing entrepreneurship education that does not merely introduce AI tools, but integrates them meaningfully into learning processes that encourage initiative, resilience, critical thinking, and business creation. As highlighted in the literature (Lynch & Corbett, 2023; Bell & Bell, 2023; Hasan et al., 2024), AI can act as a cognitive partner in entrepreneurial learning, enabling feedback loops, rapid prototyping, and reflective experimentation. However, realizing this potential requires pedagogical strategies that are intentional, inclusive, and ethically grounded.

Overall, the results indicate that while first-year students are digitally engaged and recognize the usefulness of AI in skill development, a stronger connection between these tools and entrepreneurial practice is needed. There is significant potential for educational strategies to more explicitly bridge digital tool usage with entrepreneurial activities, thus fostering a more proactive entrepreneurial mindset early in higher education.

Ethics Declaration

This research adhered to all ethical standards required for studies involving human participants. Prior to the administration of the questionnaire, ethical clearance was sought and obtained from the relevant institutional ethics committee. Participants were fully informed about the nature and purpose of the study and provided their consent to participate voluntarily. Anonymity and confidentiality were ensured throughout the data collection and analysis process.

A formal reference to the ethical approval granted for this study is included as attached to this paper.

AI Declaration

Artificial Intelligence (AI) tools were used in the development of this paper to support language refinement and structural editing. Specifically, ChatGPT by OpenAI was employed to assist with the rephrasing of academic text, grammar correction, and improving the clarity and coherence of certain sections, such as the discussion and conclusion.

All substantive academic content, including research design, data analysis, interpretation of findings, and critical arguments, was developed by the authors. The outputs generated by the AI tool were carefully reviewed, edited, and integrated into the manuscript with full academic oversight to ensure accuracy, originality, and scholarly integrity.

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An Exploration on the Impacts of Public R&D Policies

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Abstract: This paper explores the role of public funding and policies in supporting research, development, and innovation (RD&I) across various national contexts, including both developed and developing countries. The analysis assesses the impacts of such policies on innovation capacity, economic growth, and the generation of positive externalities via integrated innovation systems. Challenges faced by National Innovation Systems (NIS)—such as fragmentation between the public and private sectors and limited technological absorption—are critically examined. The paper presents practical examples highlighting the value of public-private partnerships and long-term strategic agendas to enhance RD&I outcomes. The study concludes that a coordinated approach, integrating academia, government, and industry, is vital for promoting sustainable innovation and global socioeconomic development.

Keywords: Innovation, Public Funding, Public Policies, R&D, Externalities.

1. Introduction

Innovation is a fundamental driver of economic and social advancement, especially when stimulated by public policies that support RD&I. These policies can foster innovation in both private firms and academic institutions, encouraging public-private partnerships and creating an ecosystem conducive to technological progress. However, the outcomes of such policies can vary widely, with externalities being a core aspect. In some instances, public subsidies induce crowding-in effects—stimulating additional private investment—whereas in other cases, they may cause crowding-out, displacing private resources and limiting policy effectiveness (Becker et al., 2023).

This article is structured into eight sections. It begins with this introduction, followed by a description of the methodology used to investigate the externalities of public RD&I policies. The conceptual framework then elaborates on the mechanisms of crowding-in and crowding-out. Section four discusses financial support and public investment in RD&I, and section five focuses on assessing and measuring the externalities of such policies. The sixth section explores the role of National Innovation Systems (NIS) and their interactions with public RD&I initiatives. Section seven presents a discussion of the challenges and barriers in policy implementation, and the final section concludes with recommendations aimed at maximizing positive impacts while mitigating negative externalities.

2. Methodology

This paper employs an exploratory literature review to examine the externalities of public policies supporting research, development, and innovation (RD&I), with particular emphasis on the effects of crowding-in and crowding-out. The aim is to provide a broad and critical overview of the current state of knowledge, highlighting trends and identifying gaps in the literature. To ensure a robust foundation, the review draws on peer-reviewed sources from Scopus, Web of Science, Emerald Insight, Google Scholar, and OECD iLibrary.

A targeted combination of keywords was used to guide the search, including terms such as “crowding-in and crowding-out,” “public funding of R&D”, “National Innovation Systems” and “externalities of R&D policies”. These terms were strategically selected to capture studies examining the impact of innovation policies across both developed and developing countries. The review also includes literature exploring the relationships between academia, industry, and government, with a focus on cooperation dynamics, funding mechanisms, and policy outcomes.

In total, 33 references were consulted, with 26 peer-reviewed journal articles forming the core of the analysis. A significant proportion of these focus on advanced economies such as the United States, United Kingdom, Sweden, South Korea, and the European Union (EU), while others address emerging markets like Brazil, Mexico, and Chile. Additional references include institutional reports and conference papers, enriching the comparative scope of the research. The article contributes to addressing the literature gap by incorporating insights from less-represented regions and offering context-sensitive interpretations.

3. Conceptual Basis

The effects of public RD&I policies are primarily examined through two core concepts: crowding-in and crowding-out. These mechanisms describe how public funding influences private investment behavior. Crowding-in occurs when public funding stimulates additional private sector investment, amplifying resources available for innovation. In contrast, crowding-out arises when public funding displaces private capital that would otherwise have been invested, potentially weakening the intended innovation incentives (De Fuentes et al., 2023; Santoleri et al., 2022).

National Innovation Systems (NIS) serve as the framework within which these effects unfold, promoting cooperation among government, industry, and academia. Their success depends on the system's capacity to absorb technology and coordinate efforts. In Canada, for example, strategic policies such as the Strategic Innovation Fund have effectively leveraged public investment to attract private contributions in key sectors like clean technologies and health (Becker et al., 2023; MIT Science Policy Review, 2024; OECD, 2024a).

In Brazil and Chile, public programs such as FINEP (Brazil's Funding Authority for Studies and Projects) have sought to stimulate private sector engagement without displacing existing investment. These policies foster complementarities between public and private efforts, mitigating potential crowding-out effects (Becker et al., 2023; MIT Science Policy Review, 2024; OECD, 2024a).

Chile's Start-Up Chile initiative exemplifies how public support can generate crowding-in effects by attracting foreign investment and enhancing local startup ecosystems (Crespi et al., 2020). Similarly, in South Korea, RD&I policies that emphasize strategic sectors and promote collaboration among universities, research institutions, and industry have successfully attracted private investment without substituting it (Hwang et al., 2019).

However, not all outcomes are positive. In China, evidence indicates that in sectors already capable of self-financing, public funding has sometimes substituted private investment rather than complementing it (Wang & Wang, 2021). Similarly, within the EU, certain subsidy programs for SMEs have failed to incentivize additional investment, leading to overreliance on public resources (Santoleri et al., 2022). These cases highlight that while crowding-in is often the policy goal, contextual factors may reverse the outcome, leading to unintended consequences.

4. Financial Support and Public Investment in Research, Development and Innovation (RD&I)

Public financial support plays a critical role in promoting innovation in both developed and developing economies. The European Union's Horizon Europe program, for example, allocates significant grants to foster research collaboration between universities and firms across Europe. In the United States, the Small Business Innovation Research (SBIR) program finances small innovative firms to stimulate technological advancement. In Brazil, FINEP supports high-tech sectors such as biotechnology and renewable energy. These programs demonstrate how well-designed public policies can enhance RD&I activities, encourage intersectoral cooperation, and drive economic growth (OECD, 2024a).

Funding models differ across countries. India's National Innovation Foundation (NIF) supports rural innovation through grassroots initiatives, while Brazil's Inova Empresa Program blends public-private partnerships with direct subsidies tailored to strategic sectors. These approaches allow governments to adapt funding mechanisms to regional needs, promoting localized innovation either through public investment, private engagement, or hybrid strategies (Janger et al., 2021).

Government support is justified by market failures that restrict knowledge diffusion and deter private investment in innovation. Knowledge, as a public good, often yields social returns exceeding private ones, prompting firms to underinvest. This is especially true for small firms and start-ups, which face financing barriers due to information asymmetry and risk. Instruments like subsidies and tax incentives help reduce these constraints and promote innovation capacity (Huergo & Moreno, 2017).

Public investment in RD&I also generates substantial spillover effects across sectors. South Korea's Science and Technology Strategic Plan, launched in the 2000s, integrated multiple sectors into a national innovation value chain, boosting productivity and competitiveness. Electronics, semiconductors, and software industries particularly benefited, exemplifying how coordinated strategies can amplify innovation outcomes (Deleidi & Mazzucato, 2021).

Recent OECD (2024) data reinforce the impact of these policies. In Germany, RD&I intensity increased by 2.7 percentage points, sales of new products rose by 3.1 percentage points, and export performance among SMEs improved by 4.2 percentage points. These gains are attributed to a combination of national and supranational subsidies, highlighting the potential of well-coordinated innovation policies to foster competitiveness and maximize positive externalities (OECD, 2024a).

Beyond market support, governments also foster their own innovation ecosystems. Silicon Valley exemplifies the synergy of public support, private investment, and academic partnership in creating a vibrant tech hub. Similarly, Porto Digital in Recife, Brazil, combines public initiatives with ICT sector development to stimulate innovation at the regional level. Such innovation clusters, often shaped by public policies, facilitate the integration of talent, infrastructure, and knowledge (Breschi & Malerba, 2021).

International cooperation further strengthens RD&I outcomes. The EUREKA Network, which spans over 45 countries, exemplifies how multinational collaboration can yield transformative innovations. Notably, Bluetooth technology emerged from joint efforts across European firms and research centers, underlining the effectiveness of cross-border cooperation in advancing technological development (Guan et al., 2016).

In recent years, OECD countries have increased public RD&I support, often combining direct funding and tax incentives. Countries like Belgium, Canada, and France have shifted towards tax-based instruments, with annual growth in corporate R&D tax incentives averaging 3.5%. Meanwhile, Switzerland and Sweden maintain a preference for direct public grants. In 2023, 62% of Sweden's public RD&I support came from direct funding, reflecting a centralized strategy tailored to national priorities (Dumont, 2017; OECD, 2024b).

Firm size and RD&I maturity also influence access to support. In South Korea, the coordination of 17 RD&I agencies across ministries and institutions facilitates efficient resource allocation, improving intersectoral collaboration and national competitiveness (Hwang et al., 2019).

In the United States, technology transfer from federal labs to private firms is complex but effective, relying on patents, licensing, and cooperative agreements. These tools ensure that public research outcomes are commercially leveraged, boosting innovation and international competitiveness (Link et al., 2019).

The effects of subsidies often extend beyond direct recipients. Studies show that public support generates patents and new innovations even among non-funded firms through spillovers. This multiplier effect underscores how public RD&I investment benefits entire ecosystems, not just individual enterprises (Becker et al., 2023).

Combining policy instruments such as grants and tax credits enhances long-term RD&I impact. Evidence from Ireland shows that sequenced support—first grants, followed by tax incentives—stimulates additional private investment, a phenomenon known as "additionality." This mix strengthens firms' innovation capacity and fosters sustainable development (Lenihan et al., 2024).

5. Assessment and Measurement of Externalities in Public Policies to Support RD&I

Evaluating the externalities of RD&I policies is essential for policymakers to understand the real outcomes of their interventions. Key externalities include knowledge spillovers, the creation of new markets, and environmental and social effects. Though difficult to quantify, methods such as input-output analysis, econometric modelling, and case studies are commonly used to assess the broader impacts of RD&I initiatives (OECD, 2019).

In Sweden, government subsidies have been vital in fostering innovation in high-growth sectors like artificial intelligence and biotechnology. Public funding facilitated partnerships between private firms and research institutions, resulting in new technologies and regional economic development. However, the effectiveness of such programs depends on optimized resource allocation to high-potential projects and sustained policy continuity (OECD, 2024b).

In OECD countries, evidence shows that firms receiving RD&I incentives improve not only their productivity but also generate spillovers that benefit neighboring firms. For instance, in Germany and South Korea, collaborations between businesses and academic institutions have led to measurable gains in patent output and export growth, demonstrating the importance of regional policy design in enhancing competitiveness (OECD, 2024a).

Externalities can be classified into three types of additionalities: input additionality, such as increased private RD&I investment and employment; output additionality, including new revenues from innovative products and

patent growth; and behavioral additionality, such as greater innovation propensity and reduced project abandonment. Identifying these is crucial to distinguish between crowding-in and crowding-out effects (Méndez-Morales & Muñoz, 2019).

Crowding-out occurs when public subsidies displace private investment, reducing total RD&I activity. While some studies report that subsidies may deter private funding, others show that in environments with high financial risk or limited capital, public support can increase private investment. Thus, the policy context and firm characteristics are key determinants of subsidy effectiveness (Wang & Wang, 2021).

Poorly targeted subsidies, particularly to firms with limited innovation potential, increase the risk of crowding-out. In contrast, when directed towards firms with constrained access to capital, subsidies often catalyze investments in fixed assets and technological upgrading, especially in developing countries. For example, in Chile, Start-Up Chile enabled early-stage technology firms to acquire essential infrastructure, accelerating innovations in fintech and software (Crespi et al., 2020).

Although innovation externalities are typically positive—boosting productivity, job creation, and competitiveness—some may be negative. Examples include environmental degradation or biodiversity loss. Comprehensive evaluation of these externalities is necessary to balance the benefits and mitigate potential adverse impacts of innovation policy (European Commission, 2014).

Traditional metrics, such as patent counts, university spin-offs, and return on investment (ROI), remain central in measuring innovation outcomes. However, ROI depends not only on absorptive capacity but also on how effectively public policies foster an enabling innovation environment. Furthermore, these quantitative indicators often fail to capture qualitative benefits like improved living conditions or social impact (Grossman & Helpman, 2021).

It has been argued that evaluating research performance requires going beyond publication metrics to include broader social outcomes (de Pinho & da Rosa, 2017). RD&I policies should be assessed not only for economic impact but also for their contribution to well-being, inclusion, and sustainability. Addressing social and environmental challenges through innovation demands a more holistic evaluation framework (de Pinho & da Rosa, 2017).

Complementary indicators such as process efficiency should also be considered. These help organizations assess how effectively innovation is integrated into operations, particularly in long-term projects. This is vital for firms that rely on incremental improvements to maintain competitiveness (Adams & Hardwick, 2020).

Different national contexts present specific challenges to maximizing innovation benefits. Germany's innovation system, for example, has generated strong spillovers by fostering university-industry collaboration, which increased patent registration and exports. In contrast, countries like Mexico have struggled with misaligned subsidy strategies, often resulting in crowding-out effects that limit private RD&I (Becker et al., 2023; Crespi et al., 2020; OECD, 2024a).

To address this, integrated approaches that combine tax incentives with direct subsidies have shown better results. Canada's public-private financing strategies in clean technologies demonstrate how targeted interventions can stimulate additional private investment while ensuring strategic alignment (Lenihan et al., 2024).

Performance also varies across OECD countries. Sweden, Japan, and Germany have achieved stronger outcomes, while Italy and Spain lag due to inefficient coordination. Larger economies with diversified sectors often benefit more from RD&I policies, while smaller countries such as Portugal and Norway face challenges related to scale and fragmentation. For these countries, better coordination and strategic sector focus are essential (Ziesemer, 2024).

6. National Innovation Systems and the Implementation of Public Policies for Research, Development and Innovation (RD&I)

National Innovation Systems (NIS) are critical frameworks involving networks of companies, universities, research institutes, and government bodies working together to generate, disseminate, and apply knowledge. The success of these systems depends on effective coordination among actors and the development of mechanisms that support collaboration and knowledge transfer (Godin & Gingras, 2017).

In the United States, programs like Small Business Innovation Research (SBIR) and the Advanced Technology Program (ATP) illustrate how federal initiatives promote innovation in small and medium-sized enterprises (SMEs). These initiatives strengthen university-business partnerships and enable the creation of new technologies. The Silicon Valley ecosystem exemplifies the benefits of aligning public policy, private investment, and world-class academic institutions such as Stanford University (Garcia & Calantone, 2018).

The European Union (EU) also supports a robust NIS through initiatives like Horizon Europe, which funds cross-border collaboration in RD&I. Despite progress, challenges remain in aligning funding mechanisms among member states and ensuring equitable access to resources for startups and SMEs, which can hinder the full realization of the region's innovative potential (Tödtling & Trippl, 2020).

South Korea has successfully implemented coordinated RD&I policies, investing heavily in strategic sectors like electronics and biotechnology. Strong linkages among government, universities, and industry are supported by innovation hubs, tax incentives, and intellectual property protections. However, gaps persist in supporting startups and ensuring that resources are not overly concentrated in large conglomerates (Kim & Lee, 2017).

Latin American countries such as Argentina, Chile, Colombia, Mexico, and Peru face structural constraints in their NIS, including weak infrastructure, limited funding, and insufficient coordination among stakeholders. While technology clusters and innovation networks show promise, SMEs often struggle to absorb and implement new technologies. These challenges highlight the need for capacity building, strategic investment, and stronger stakeholder engagement (O'Connor et al., 2017).

Brazil's NIS has benefitted from agencies like FINEP, which finance RD&I projects in companies and research institutions. Nonetheless, structural weaknesses remain, such as the disconnect between research and production systems, low innovation propensity among firms, and inefficiencies in resource allocation. The lack of a long-term innovation strategy further limits Brazil's potential to scale innovation outcomes (Mazzucato & Penna, 2023).

Portugal has implemented public RD&I initiatives such as UPTEC (Science and Technology Park of the University of Porto) and programs like Portugal 2020 and SIFIDE (System of Tax Incentives for Business RD&I). These have boosted business competitiveness and internationalization. However, knowledge transfer between academia and the private sector remains a persistent bottleneck in the Portuguese NIS (Carvalho et al., 2021).

A well-functioning NIS requires more than funding—it demands coordination, shared vision, and policy alignment. Governments must ensure synergy among stakeholders and deploy instruments that reinforce collaboration. Where well structured, public policies can support integrated systems that amplify innovation, economic growth, and social progress (OECD, 2024a).

In conclusion, despite their diversity, NIS across countries share common needs: strong intersectoral collaboration, targeted public policy instruments, and context-sensitive approaches. The experiences of the United States, EU, South Korea, Brazil, Portugal, and Latin American countries underline the importance of tailoring public RD&I policies to local capabilities while fostering global connectivity and resilience (Carvalho et al., 2021; Garcia & Calantone, 2018; Kim & Lee, 2017; Mazzucato & Penna, 2023; O'Connor et al., 2017; Tödtling & Trippl, 2020).

7. Challenges and Barriers in the Implementation of Public RD&I Policies in National Innovation Systems

National Innovation Systems (NIS) face distinct challenges depending on countries' development levels and socioeconomic conditions. In developed economies such as the United States, South Korea, and EU member states, coordination among government, academia, and industry remains a central challenge. The integration of emerging technologies like artificial intelligence and biotechnology into industrial processes demands not only infrastructure investment but also enhanced public-private collaboration. Regional disparities further exacerbate the issue, as less-developed areas often lack the resources and institutions to support innovation, concentrating activities in already advanced regions (Garcia & Calantone, 2018; Tödtling & Trippl, 2020).

In developing countries such as Brazil, Mexico, and Chile, barriers are more structural. Limited funding, weak infrastructure, excessive bureaucracy, and fragmented innovation ecosystems hinder progress. The low absorption capacity for new technologies among small firms and the absence of a robust innovation culture among companies further restrict development. However, targeted programs such as FINEP in Brazil and Start-Up Chile demonstrate that well-coordinated public interventions can help overcome some of these barriers.

International cooperation networks and locally adapted tax incentives have also shown promise in enhancing technological capability and promoting sustainable development (Mazzucato & Penna, 2023; O'Connor et al., 2017).

A recurring challenge in many developing contexts is partial crowding-out, where public subsidies replace private RD&I investments. While this substitution is often viewed negatively, it can be beneficial when financially constrained firms use public support to invest in capital goods and improve their technological infrastructure. For instance, Start-Up Chile enabled several early-stage firms to acquire equipment they could not have financed otherwise, accelerating innovation in key sectors (Crespi et al., 2020).

To address these challenges, countries must tailor public policies to their local contexts while promoting coordination and inclusiveness. In developed economies, improving the integration of new technologies and reducing regional disparities is key. In developing countries, capacity building, infrastructure enhancement, and the promotion of innovation-oriented business cultures are essential. Only through context-sensitive, collaborative, and forward-looking policies will it be possible to strengthen NIS and ensure long-term, sustainable innovation (Mazzucato & Penna, 2023; OECD, 2024a).

8. Conclusion

This study examined components of National Innovation Systems (NIS) in varying socioeconomic contexts, highlighting the relationship between public RD&I policies and the performance of these systems in both developed and developing countries. The aim was to understand the interactions, challenges, and barriers influencing policy implementation and how they affect innovation capacity, economic growth, and competitiveness.

Findings show that while advanced economies such as the United States, South Korea, and the European Union face issues related to coordination and integration of emerging technologies, developing countries like Brazil and Chile encounter structural constraints including insufficient funding and weak technological absorption. However, when public RD&I policies are effectively designed and adapted to national contexts, they can foster cooperation between academia, government, and industry, enhancing the collective innovation ecosystem.

The results underscore the importance of flexible policy frameworks that account for local specificities while encouraging global connectivity and collaboration. Effective policy design must go beyond isolated instruments and instead foster systemic integration, aligning fiscal tools, direct subsidies, and strategic agendas to maximize both national and international innovation outcomes. International networks, targeted incentives, and coordinated infrastructure development emerge as powerful mechanisms to overcome persistent innovation barriers.

The study suggests that innovation clusters, such as Silicon Valley and Medicon Valley, offer important lessons for building dynamic ecosystems. Their success stems from a combination of concentrated talent, public and private investment, and university-industry collaboration—all reinforced by consistent policy support. Adapting these strategies to regional needs can foster competitiveness and entrepreneurship in both high-income and emerging economies.

By examining the diversity of NIS configurations and their interactions with public RD&I policies, this study proposes a set of guiding principles that can be adapted to various national contexts. A key factor in success is sustained coordination between stakeholders, backed by a shared commitment to long-term innovation goals. Building capacity for such coordination requires not only financial investment but also institutional alignment and cultural change (Mazzucato & Penna, 2023; OECD, 2024a).

Future research and policy efforts should focus on refining mechanisms for effective integration of innovation subsystems, reducing redundancies, and closing institutional gaps. Open questions remain: How can flexible policies be designed to suit both high-capacity systems and resource-constrained environments? What tools best promote long-term collaboration between government, academia, and industry? How can innovation be harnessed to address not only economic growth but also social equity and environmental sustainability?

A possible answer lies in the deployment of scalable policy tools tailored to local realities. These may include innovation clusters, tax incentives, training programs, and instruments that value regional specificity, such as geographical indication labels and local quality standards. In less industrialized regions, such tools can add value, integrate local products into global markets, and support inclusive development.

Additionally, the digital transformation offers new avenues for innovation in marginalized areas. Promoting access to technologies such as artificial intelligence and the Internet of Things can help integrate these regions into global innovation systems, ensuring balanced and sustainable development. International cooperation and participation in global innovation platforms can further expand the reach and impact of national RD&I policies (OECD, 2024a; WIPO, 2017).

Finally, the success of public RD&I policies depends on the continuous evaluation of their impacts. Systematic monitoring using clear performance indicators—such as innovation rates, patents, exports, and university-industry collaboration—is essential. As societal needs evolve, policies must remain adaptable and responsive. Feedback mechanisms and regular impact assessments will help identify bottlenecks and opportunities for improvement, enabling innovation policy to serve as a cornerstone of sustainable and inclusive growth (OECD, 2024a; WIPO, 2017).

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Ethics Declaration

Ethical clearance was not required for the research.

AI Declaration

AI tools were not used in the creation of this paper.

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Artificial Intelligence and Green Innovation: A Pathway to Sustainable Business Practices

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Abstract: Companies today face growing challenges in becoming sustainable. Sustainable business models help companies address environmental, social, and economic problems in creative and responsible ways. This study looks at how artificial intelligence (AI) supports sustainable business models, with a focus on the role of green innovation (such as eco-friendly technologies) in this process. A correlational research design, structural equation modelling (SEM) was applied to survey data collected from 118 senior managers and executives working in science and technology parks across Iran. The findings reveal that AI significantly strengthens both green innovation practices and sustainable business model. Furthermore, green innovation not only directly enhances sustainable business models but also acts as a mediator in relationship between AI and long-term sustainability outcomes. This suggests a sequential relationship: AI adoption drives advancements in green innovation, which in turn enables organizations to reimagine their business models to align with global sustainability goals.

Keywords: Artificial Intelligence, Green Innovation, Sustainable Business Model Innovation; SEM

1. Introduction

The most significant challenge facing organizations today is the reality of transformation and change. Undoubtedly, an organization's ability to adapt to such changes is critical to its long-term survival. In today's dynamic and highly competitive market, innovation is crucial for organizational sustainability (Noruzy et al., 2013). Moreover, environmental performance and compliance with ecological regulations now serve as competitive advantages for businesses (Tseng et al., 2013; Wiredu et al., 2024). Consequently, aligning innovations with environmental considerations is imperative. This necessity has given rise to the concept of sustainable innovation, which emphasizes that all innovations must contribute to improving an organization's environmental efficiency. Examples include innovations in production processes that reduce energy and natural resource consumption, enhance recycling efficiency, or minimize environmental pollution (Adomako & Tran, 2024; Ribeiro et al., 2024).

1.1 Sustainable Business Model Innovation

Business model innovation is critical for corporate survival, business performance, and as a source of competitive advantage (Casadesus-Masanell & Zhu, 2013; Ramdani et al., 2019; Gholami et al., 2013). By pursuing innovation in their business models, companies explore novel ways to redefine value propositions, create value, and deliver value to customers, suppliers, and partners (Nazari-Shirkouhi et al., 2015; Bock et al., 2012). Business model innovation is defined as "intentional, innovative, and non-marginal changes to a *firm's core business model elements and/or the architecture linking these elements"* (Foss & Saebi, 2017, p. 201). Business model innovations potentially yield higher returns than product or process innovations (Lindgardt et al., 2012), and sustainable business models may provide additional advantages, such as risk reduction and enhanced resilience (Tavana et al., 2021; Choi & Wang, 2009), while creating opportunities for diversification and shared value (Porter & Kramer, 2011). To realize these benefits, organizations are increasingly adopting sustainable solutions (Geissdoerfer et al., 2018). Sustainable business model innovation has emerged as a promising approach to advancing corporate sustainability (Guo et al., 2022), which prioritizes generating economic, environmental, and social benefits for all stakeholders over traditional profit-maximization objectives (Bocken et al., 2014; Roshan & Balodi, 2024).

1.2 Green Innovation

Green innovation refers to innovations in products, processes, and management that enable organizations to achieve environmentally sustainable competitive advantages (Agrawal et al., 2024). Seman et al. (2012) define green innovation as software- or hardware-based technological innovations tied to green products or processes, such as energy conservation, waste recycling, eco-friendly product design, or organizational environmental management. Additionally, organizational innovation is regarded as a new perspective, idea, product, service, or process aimed at reducing negative environmental impacts (Liu et al., 2021). Broadly, the goal of green

innovation is to mitigate adverse environmental effects (Tseng et al., 2013; Alipour et al., 2022; Zameer et al., 2020), and it plays a critical role across the entire value chain, from suppliers to consumers (Zhu et al., 2010; Nazari-Shirkouhi et al., 2023a). Studies have demonstrated that green innovation significantly and positively influences sustainable business performance (Heidari et al., 2025; Baeshen et al., 2021; Zhao & Huang, 2022; Liu et al., 2023; Borah et al., 2025).

1.3 Artificial Intelligence

Artificial intelligence (AI) refers to machines designed to perform intelligent tasks traditionally carried out by humans (Karizaki et al., 2024; Wang et al., 2022). Today, AI and blockchain technologies can revolutionize existing processes, develop innovative business models, and transform industries (Ertel, 2024). AI adoption reduces costs and enhances business forecasting and operations (Agarwal et al., 2021). Consequently, organizations increasingly focus on AI due to its high potential for improving performance (Badghish & Soomro, 2024). AI offers opportunities to address modern societal challenges, significantly contributing to quality of life and environmental conservation (de Andreis et al., 2024). AI can optimize production processes, enhance resource efficiency, and facilitate the creation of eco-friendly materials. By leveraging AI, manufacturers can reduce environmental footprints while improving operational efficiency and product quality. AI enables effective resource management, minimizes waste, optimizes production, and supports sustainable material development—key factors in advancing industries toward more sustainable production paradigms (Lodhi et al., 2024; Wang & Zhang, 2025; de Andreis et al., 2024). Furthermore, studies highlight AI's role in driving green innovation (Wang et al., 2025; Cheng et al., 2025; Farmanesh et al., 2025). Recent studies, such as Latifi et al. (2024), emphasize the importance of technological quality frameworks—similar to those applied in virtual reality contexts—in understanding how technological attributes influence user perceptions and behavioral intentions, which can be extended to green innovation and sustainable practices.

1.4 Conceptual Model

In today's world, AI stands as one of the most transformative modern technologies, reshaping numerous facets of business. This technology enables organizations to achieve significant improvements in their processes, products, and services. However, alongside AI's numerous advantages, challenges persist in implementing sustainable business models. Sustainable business models are designed to benefit not only organizations but also society and the environment. In this context, green innovation is recognized as a key approach that empowers organizations to optimize natural resource utilization and reduce adverse environmental impacts. Consequently, this study investigates AI's role in driving sustainable business model innovation, with a specific focus on analyzing the mediating role of green innovation in this process. The findings can guide organizations in designing more effective strategies to integrate AI and green innovation into their business models, thereby advancing sustainable development and minimizing environmental harm. Figure 1 illustrates the research's conceptual model.

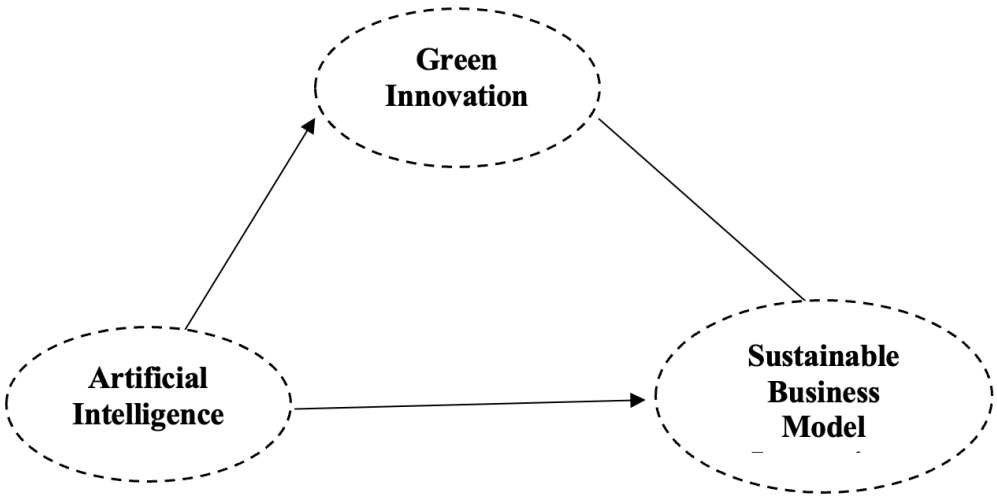


Figure 1: Research Conceptual Model

2. Research Methodology

The present study employs a descriptive-correlational methodology based on structural equation modeling (SEM), as it investigates relationships between variables through a structural equation modeling framework.

2.1 Statistical Population and Sample

The statistical population consisted of managers and deputy managers of Iranian science and technology companies. A total of 130 questionnaires were distributed among this population in 2024, of which 118 were returned and analyzed.

2.2 Data Collection Tools

Sustainable Business Model Innovation (SBMI) was measured using the 9-item questionnaire developed by Bhatti et al. (2021). Green Innovation (GI) was assessed via the 6-item questionnaire by Chang (2011). AI was evaluated using the 22-item questionnaire by Chen et al. (2022). This tool measures five dimensions: AI Management (3 items); AI-Based Decision-Making (4 items); AI Infrastructure (5 items); AI Skills (5 items); AI Readiness (5 items). All items were rated on a five-point Likert scale ranging from *strongly disagree* (1) to *strongly agree* (5).

3. Findings

3.1 Measurement Model Test

The measurement model evaluates the reliability (internal consistency) and discriminant validity of constructs and instruments. Based on Nazari-Shirkouhi et al. (2023b) framework, three criteria were applied: Item reliability: Confirmatory factor analysis (CFA) factor loadings ≥ 0.6, with statistical significance ($p<0.01$) validated via a 500-subsample bootstrap test (Gefen & Straub, 2005; Tavana et al., 2021; Tavana et al., 2022). Composite reliability: Assessed using Dillon-Goldstein's rho (ρc), requiring values ≥ 0.7. Average variance extracted (AVE): Threshold of ≥ 0.50, indicating the construct explains ≥50% of indicator variance (Chin, 1988). As shown in Table 1, all constructs met these criteria, confirming robust reliability and validity of the measurement model.

Table 1: Factor Loadings, Composite Reliability, and Average Variance Extracted (AVE) of Research Variables

Variable	Item	Factor Loading	Cronbach's alpha	Composite reliability	Average variance extracted
AI Management	1	0.947	0.868	0.921	0.798
	2	0.95			
	3	0.771			
AI-Based Decision-Making	1	0.894	0.890	0.924	0.754
	2	0.892			
	3	0.889			
	4	0.794			
AI Infrastructure	1	0.795	0.807	0.868	0.571
	2	0.646			
	3	0.653			
	4	0.817			
	5	0.843			
AI Skills	1	0.806	0.905	0.929	0.724
	2	0.841			
	3	0.848			
	4	0.885			
	5	0.874			

Variable	Item	Factor Loading	Cronbach's alpha	Composite reliability	Average variance extracted
AI Readiness	1	0.83	0.865	0.903	0.650
	2	0.787			
	3	0.825			
	4	0.758			
	5	0.828			
Green Innovation	1	0.837	0.913	0.933	0.699
	2	0.891			
	3	0.842			
	4	0.84			
	5	0.87			
	6	0.729			
Sustainable Business Model Innovation	1	0.887	0.944	0.953	0.692
	2	0.875			
	3	0.795			
	4	0.803			
	5	0.778			
	6	0.794			
	7	0.882			
	8	0.853			
	9	0.81			

Discriminant validity was evaluated using two criteria outlined by Chin (1988): first, item alignment, which requires that indicators load most strongly on their assigned construct—meaning higher factor loadings on their own construct than on others—with minimal cross-loadings; and second, the AVE comparison, where the square root of the AVE for each construct must exceed its correlations with all other constructs.

Table 2: Cross-Factor Loadings for Assessing Questionnaire Validity

	AI	Green Innovation	Sustainable Business Model Innovation
AI1	**0.947**	0.468	0.413
AI2	**0.950**	0.450	0.424
AI3	**0.771**	0.461	0.385
AI4	**0.894**	0.480	0.338
AI5	**0.892**	0.610	0.451
AI6	**0.889**	0.538	0.414
AI7	**0.794**	0.434	0.406
AI8	**0.817**	0.604	0.425
AI9	**0.843**	0.606	0.344
AI10	**0.795**	0.627	0.444
AI11	**0.646**	0.289	0.329
AI12	**0.653**	0.498	0.354
AI13	**0.806**	0.481	0.402
AI14	**0.841**	0.460	0.533
AI15	**0.848**	0.447	0.446

	AI	Green Innovation	Sustainable Business Model Innovation
AI16	**0.885**	0.435	0.437
AI17	**0.874**	0.531	0.471
AI18	**0.787**	0.342	0.351
AI19	**0.825**	0.411	0.282
AI20	**0.758**	0.438	0.345
AI21	**0.830**	0.531	0.524
AI22	**0.828**	0.439	0.398
GI1	0.560	**0.837**	0.516
GI2	0.600	**0.891**	0.546
GI3	0.554	**0.842**	0.481
GI4	0.536	**0.840**	0.500
GI5	0.595	**0.870**	0.474
GI6	0.524	**0.729**	0.409
SBMI2	0.540	0.518	**0.887**
SBMI3	0.434	0.453	**0.875**
SBMI4	0.378	0.414	**0.795**
SBMI5	0.478	0.482	**0.803**
SBMI6	0.521	0.465	**0.778**
SBMI7	0.464	0.482	**0.794**
SBMI8	0.532	0.547	**0.882**
SBMI9	0.505	0.448	**0.853**
SBMI1	0.349	0.426	**0.810**

As shown in Table 2, all dimensions demonstrate the highest factor loadings on their respective constructs, with a minimum gap of 0.1 between their own construct's loadings and those of others. This confirms the adequate discriminant validity of the research constructs.

Table 3 reveals that the square roots of AVE for all research variables are greater than their correlations with other variables, satisfying the second criterion for discriminant validity. Additionally, the sub-diagonal correlation coefficients indicate positive and significant relationships between all variables.

Table 3: Correlation Matrix and Square Roots of AVE

	AI	Green Innovation	Sustainable Business Model Innovation
AI	**0.861**		
Green Innovation	0.672	**0.836**	
Sustainable Business Model Innovation	0.569	0.585	**0.832**

3.2 Structural Model Test

The proposed conceptual model for predicting sustainable business model innovation was evaluated using SEM. To test the hypotheses, the Partial Least Squares (PLS) method was employed for model estimation. A bootstrap test (with 500 subsamples) was applied to calculate t-statistics for determining the significance of path coefficients. Figure 2 illustrates the tested model, depicting relationships between variables, with values inside circles representing the explained variance of the constructs.

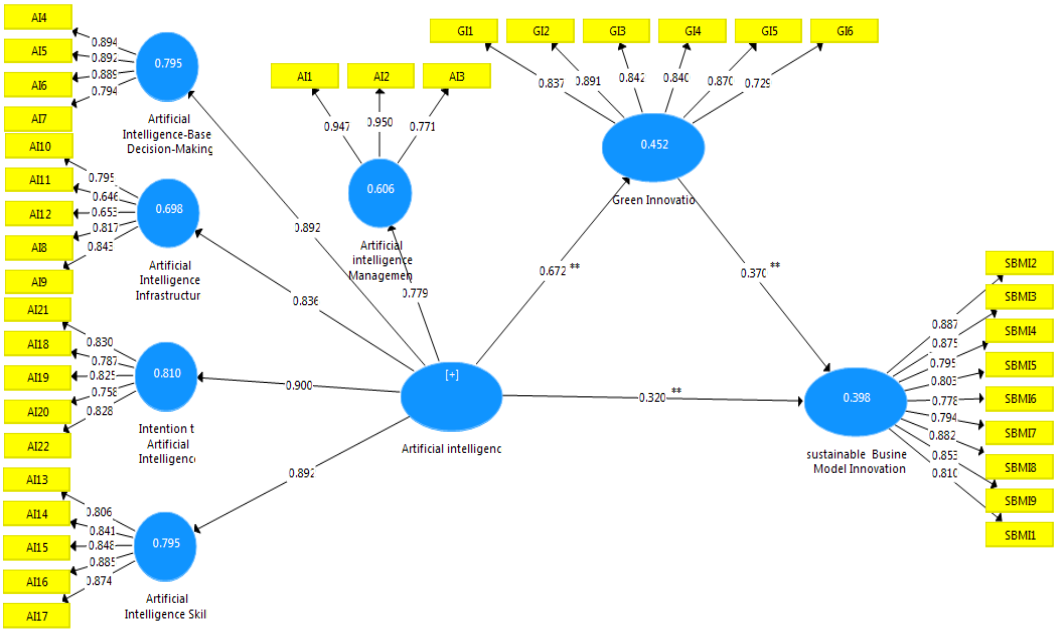


Figure 2: Tested Model

Table 4 reports the estimated path coefficients and explained variance of the research variables.

Table 4: Path Coefficients and Explained Variance

Variables	Path Coefficients	t-Values	Explained Variance
On Sustainable Business Model Innovation from:			
Green Innovation	0.37**	3.153	0.398
AI	0.32**	3.361	0.398
On Green Innovation from:			
AI	0.67**	11.688	0.45

*p<0.05, **p<0.01

As shown in Table 4, the effects of AI on green innovation and sustainable business model innovation are positive and statistically significant. Similarly, the impact of green innovation on sustainable business model innovation is also positive and significant. Furthermore, the model explains 40% of the variance in sustainable business model innovation and 45% of the variance in green innovation. Table 5 presents the indirect coefficients.

Table 5: Indirect Coefficients

Indirect Paths	Indirect Effects	T Statistics	P Values
AI -> Green Innovation -> sustainable Business Model Innovation	0.249	2.997	0.003

As observed in Table 5, green innovation plays a significant and positive mediating role in the effect of AI on sustainable business model innovation. For the tested model in this study, the absolute Goodness-of-Fit Index (GOF) value was 0.66, indicating a strong model fit. Values above 0.36 are considered acceptable and reflect adequate model quality.

4. Discussion

The present study aimed to investigate the impact of AI on sustainable business model innovation through the mediating role of green innovation using SEM. Results indicated that the proposed model demonstrated a relatively good fit with the data, explaining 40% of the variance in sustainable business model innovation and 45% of the variance in green innovation.

The results revealed a positive and significant effect of AI on green innovation. This finding aligns with studies by Wang et al. (2025), Cheng et al. (2025), and Farmanesh et al. (2025). AI's ability to provide innovative solutions for environmental challenges—such as optimizing energy consumption, streamlining supply chains, and minimizing waste—plays a critical role in advancing sustainable technologies. For instance, AI-driven simulations and predictive analytics enable organizations to forecast environmental impacts, facilitating data-driven decisions for eco-friendly strategies. Furthermore, AI enhances cross-organizational collaboration, accelerating the development and adoption of green innovations.

AI also exerted a positive and significant influence on sustainable business model innovation, consistent with findings from Lodhi et al. (2024), Wang & Zhang (2025), and de Andreis et al. (2024). As a transformative technology, AI empowers businesses to redesign operational processes, reduce costs, and align economic goals with environmental sustainability. Machine learning algorithms enable organizations to identify inefficiencies, optimize resource use, and tailor customer-centric solutions that balance profitability with ecological responsibility and business performance (Bagherabad et al., 2025). By analyzing consumer behavior, AI tools helps firms develop products and services that meet market demands while adhering to sustainability principles (Saremi et al., 2024).

Green innovation significantly mediated the relationship between AI and sustainable business model innovation. This result corroborates research by Baeshen et al. (2021), Zhao & Huang (2022), Liu et al. (2023), and Borah et al. (2025). Green innovation drives systemic changes in organizational processes, products, and services, reducing ecological footprints while enhancing economic efficiency. By integrating clean technologies and sustainable practices, businesses achieve cost savings, strengthen brand reputation, and unlock new market opportunities. Continuous improvements in supply chain management and waste reduction further solidify the alignment between innovation and long-term sustainability (Nazari-Shirkouhi and Samadi, 2025).

5. Conclusion

This study aimed to investigate the impact of AI on sustainable business model innovation and the mediating role of green innovation. Findings revealed that AI has a positive and significant effect on green innovation, aligning with prior research. AI serves as a creative and effective tool for addressing environmental challenges, fostering technologies that reduce resource consumption and minimize ecological footprints. For instance, AI optimizes energy management, supply chains, and waste reduction while enabling predictive simulations for sustainable decision-making. AI also directly enhances sustainable business model innovation by empowering organizations to design novel solutions that create customer value and achieve economic, social, and environmental sustainability. Key mechanisms include process optimization, cost reduction, and data-driven insights into consumer preferences, enabling firms to balance profitability with ecological responsibility. The mediating role of green innovation underscores its importance in translating AI's potential into sustainable business practices. By integrating clean technologies and circular economy principles, organizations reduce operational waste, strengthen brand reputation, and unlock new market opportunities. In summary, this research highlights the critical role of AI and green innovation in advancing sustainable development goals. These findings emphasize the need for businesses to prioritize AI-driven strategies and green practices to remain competitive while fulfilling their social and environmental responsibilities.

In contrast to prior research that primarily examines the direct effects of AI or green innovation separately, our study investigates the mediating role of green innovation in the relationship between AI and sustainable business model innovation. Unlike earlier studies limited to specific technological applications or industry contexts, our research provides a comprehensive model based on data collected from Iranian science and technology parks, offering regional insights into how AI-driven green innovation facilitates sustainable business transformation. Additionally, by employing SEM approach, we quantitatively demonstrate the sequential process through which AI adoption fosters green innovation, which subsequently leads to sustainable business model innovation, thus advancing theoretical understanding of these interconnected phenomena.

5.1 Limitations and Future Directions

A primary limitation of this study is its reliance on self-reported data collected through questionnaires, which may be influenced by respondents' biases. To enhance the validity of findings, future research could adopt mixed-methods approaches (qualitative and quantitative) to gain deeper insights into the relationships between variables. Additionally, this study focused on managers and deputy managers of Iranian science and technology companies, and the results may be shaped by cultural, economic, and social factors specific to this region. Future studies could explore how these factors influence variable relationships across diverse contexts to improve generalizability.

Another limitation is the cross-sectional design, which restricts conclusions to a specific time frame. Longitudinal designs in future research could examine how innovation-related behaviors and variable impacts evolve over time. Finally, the correlational nature of this study must be acknowledged. While results indicate relationships between variables, causal inferences should be drawn cautiously.

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Ethics Declaration

This research did not involve any human or animal subjects requiring formal ethical clearance. All data were collected through voluntary, anonymous surveys and complied with institutional and professional ethical standards.

AI Declaration

Artificial intelligence tools were not used in the generation of content or analysis in this paper. All writing, data collection, and analysis were conducted manually by the authors.

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Business Advisors and SMEs in the Digital Era: Essential Skills

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Abstract: Small and medium-sized enterprises (SMEs) play a key role in the European economy, but they often face challenges in keeping up with digitalisation. Business advisors serve as an essential part of the support infrastructure for SMEs. This article explores the alignment between SMEs' digital needs and the digital know-how and future priorities of business advisors. The central research question is: How well do the current competencies and future development priorities of business advisors correspond with the digital development needs expressed by SMEs? The study follows a descriptive and comparative research approach, based on two online survey datasets: one targeting 118 SMEs and the other 100 business advisors from different public advisory organisations in Finland. The results indicate that SMEs and business advisors agree on key areas of digital competence. Although both groups share a mutual understanding of digital priorities, there are differences in the use of tools, which can undermine the effectiveness of business advice. To effectively support SMEs, business advisors need to have up-to-date digital skills and the organisational conditions to apply them in practice. Bridging these gaps requires targeted training, better application of digital tools in daily work and continuous competence development for both business advisors and SMEs.

Keywords: Digital Competence, Business Advisors, SMEs, Digital Transformation, Future Skills

1. Introduction

According to the European Commission (European Recommendation 2003/361), small and medium-sized enterprises (SMEs) are enterprises with fewer than 250 employees and an annual turnover of up to EUR 50 million or a balance sheet total of up to EUR 43 million. Within the category, small enterprises have fewer than 50 and turnover or balance sheet total up to EUR 10 million, and microenterprises have fewer than 10 employees and turnover or balance sheet total up to EUR 2 million. Small and medium-sized enterprises (SMEs) represent 99% of all businesses in the EU. In Finland, there are 455,265 companies, excluding agriculture, forestry, and fisheries. These companies employ 1.46 million people and contribute significantly to public finances. Most of these companies, 95.7 per cent, have 10 employees or fewer. SMEs generate more than half (54.1%) of total corporate turnover and account for approximately 40 percent of national GDP (European Union 2003; European Commission 2025; Yrittäjät 2025).

Business advisory services in Finland are provided through a wide public support network. These include municipality-owned regional development companies, municipal business support units, and national organisations such as the Centre for Economic Development, Transport, and the Environment (ELY Centre). Additionally, associations and specialised service providers complement the national infrastructure (Työmarkkinatori 2024; Studentum n.d.). Across the country, 41 enterprise agencies and 57 regional or municipal business development organisations offer free and confidential counselling. These services are available to those interested in starting a business and entrepreneurs who want to develop their existing operations. (Yrittäjät 2025; Uusyrityskeskus 2025; Sekes 2025). Development agencies are non-profit organisations owned by municipalities. Their mission is to strengthen the competitiveness of local enterprises and promote regional economic prosperity. Their services are based on long-term client relationships, local knowledge, and trust. These agencies support businesses through all phases of the business lifecycle, including initial sparring, ideation, and early operation support, as well as growth, development, and ownership changes. As business services move increasingly into digital networks, the value of close personal advisory relationships is growing (Sekes 2025). Business advisors support both aspiring entrepreneurs and existing companies by guiding start-ups and developing business operations. Their expertise typically covers areas such as business planning, financial forecasting, taxation, legal structures, marketing, and corporate acquisitions. The profession requires strong knowledge of business fundamentals, customer-oriented thinking, and problem-solving skills. As SMEs increasingly face challenges linked to digitalisation and artificial intelligence (AI), the role of business advisors is evolving beyond traditional advisory functions.

This study explores the alignment between the digital training needs of SMEs and the current digital competence and future skill requirements of business advisors. It examines how well business advisors' expertise corresponds with the evolving demands of SMEs in the context of the digital transformation. The study draws on two complementary datasets: one collected from 118 SME representatives in the South Savo region of Finland, and

another from 100 business advisors across the country. The SME dataset focuses on identified training needs related to digital business, while the advisor dataset captures the use of digital tools and current and future competence requirements. Comparing the datasets enables gaining practical insights into how business advisory services can be better aligned with the digital development needs of SMEs. The findings help to identify gaps and synergies between entrepreneurs' expectations and advisors' capabilities, which can be used to support the ongoing development of effective, future-oriented business advisory work.

2. Background

Digitalisation can be globally described as the major technological trend (Leviäkangas 2016). Hellsten and Paunu (2021) name digitalisation as a key part of every modern firm. Utilising digitalisation can bring clear benefits such as higher quality information and faster decision-making. Kraus et al. (2021) highlight digital transformation as key for businesses to remain competitive in an increasingly digital economy. Despite the growing integration of digital technologies, SMEs persistently fall behind larger firms in digitalisation (Faiz et al. 2024). Digitalisation can offer SMEs significant opportunities to enhance performance, foster innovation, improve productivity, and compete more equally with larger firms. Yet, many SMEs lag in adopting digital technologies. This is often due to limited awareness, constrained financial and human resources, and gaps in digital capabilities (OECD 2025; Kahveci 2025).

In the concept of digitalisation of SMEs, business advisors play a key role. As digitalisation becomes more central to business development, business advisors are expected to provide support that goes beyond traditional business counselling (Uusyrityskeskus 2025). Their ability to translate complex technological solutions into relevant and actionable guidance can influence whether SMEs succeed in their digital transition. This shift also demands new competences from business advisors, particularly related to digital tools, platforms, and innovation management. While digital technologies increase organisational agility, SMEs typically face greater barriers in implementing them than larger companies (Moreira et al. 2025). Many are unfamiliar with available digital solutions or lack the necessary knowledge to assess their usefulness (Telukdarie et al. 2023). External issues also play a role alongside internal challenges, such as scarce resources or limited strategic capacity. These include imperfections in state support systems and the need to modernise traditional business models to facilitate digital transformation (Strilets et al. 2022).

Digital transformation (DT) has changed from being just a technological opportunity to something businesses now need to meet the growing needs of people. (Kraus et al., 2021). Digital transformation should not be perceived merely as a technological leap. It goes beyond upgrading software and hardware: it requires the adaptation of the institutional and operational ecosystems of an organisation to embrace new business models and ways of thinking. The goal is to keep pace with digitisation by leveraging digital tools and strategies. However, the digital transformation is not just about digitisation. At its core, it is the application of a flexible, adaptive business model that enables organisations to thrive in a digital environment (Ulas 2019). Recent research shows that while all companies have some capacity for digital transformation, but to turn this into a competitive advantage requires targeted development (González-Varona et al. 2021). Moreover, SMEs often lack the strategic, empirical, and practical knowledge needed to take full advantage of digital opportunities (Sagala & Őri 2024). To address these challenges, the digitalisation of business processes is increasingly seen as essential for long-term sustainability. It enables better data use, operational efficiency, customer retention, and cost reduction (Strilets et al. 2022). However, this transformation is not merely a technical upgrade, it often requires structural changes in how companies operate and learn. As such, the role of business advisors becomes more strategic: they help bridge the gap between policy, technology, and practical decision-making. Looking ahead, technologies such as artificial intelligence (AI), financial technologies (fintech), and cybersecurity are expected to further influence SME competitiveness. Digitalisation also opens doors to new markets and supports more sustainable and responsible business practices (Bianchini & Lasheras Sancho 2025). For SMEs to benefit, however, both their internal capabilities and the public support system, especially business advisory services, must continue to develop.

3. Methodology

The study draws on two separate datasets: one collected from SMEs and the other from business advisors, both collected as part of the *Digital Steps – Towards customer-oriented digital business* project. The objective is to compare the SMEs' digital training needs with the current use of digital tools and self-identified development priorities and future skill requirements of business advisors. The research approach is based on

applied, practical research. The use of two different perspectives, covering both the demand side (SMEs) and the support side (business advisors), helps to create a more diverse picture of digital competence development needs. The study uses a descriptive survey design, which allows for comparison between two groups of respondents.

The SME data was collected in the South Savo region, Finland between November 2023 and February 2025 from SMEs interested in developing their digital business. The survey was part of the project's skills mapping. The survey was conducted as a structured online survey on Hyviö, an application that measures the effectiveness of services. (Hyviö 2025). A total of 118 companies responded the survey, representing approximately 65% of the contacted SMEs. The results of the survey were originally intended to support the design of training courses offered during the project to meet the needs of SMEs. In this study, the focus is on SMEs digital training needs. The needs assessment was structured around seven thematic areas reflecting different dimensions of digitalisation: *(1) content creation for digital platforms, (2) digital advertising and marketing, (3) data management, analysis and utilisation, (4) online visibility, (5) e-commerce and digital sales, (6) customer understanding and service, and (7) strategic objectives of digital business* (see Table 1). Each theme included four core aspects, resulting in 28 distinct items. Respondents were asked to select any areas relevant to their own interests or development needs. The number of choices was not limited, allowing participants to indicate all applicable training areas. The analysis of SME responses is based on descriptive statistical methods, specifically frequency distributions and percentages. This approach was chosen to clearly illustrate the most identified digital training needs. The original goal was to provide a practical, needs-oriented overview that supported planning of training and advisory services. In this article, the data is used to examine how SMEs' training needs correspond with the digital competence priorities reported by business advisors.

The second dataset was collected via a nationwide online survey, conducted using the Webropol platform, targeting professionals working in public business advisory organisations across Finland. The target group included advisors involved in providing digitalisation-related support to SMEs. One of the main objectives of the business advisors' competency assessments was to provide up-to-date information on their digital skills and to identify development suggestions. Participation was voluntary and anonymous, and no incentives were offered. The survey link was distributed via email, newsletters, and relevant social media networks. The survey was open from 17 February 2025 to 2 March 2025. The questionnaire included 19 different question sections. It included Likert scale questions on tool usage frequency, multiple-choice questions about current and future digital skills, and open-ended questions to gather more in-depth insights. The instrument was based on the themes of the Digital Steps project. In total, 100 responses were received. As the survey was partly distributed through multiple open channels, the total number of recipients is not known, and therefore, a response rate could not be calculated. Respondents represented a variety of public advisory organisations across different regions of Finland. This article focuses on quantitative data, specifically the responses related to digital tool usage and skill development priorities. These data are analysed using frequency distributions, percentages, means, and medians. The full dataset has been previously presented in another publication (Saali 2025). The current article presents a targeted analysis aligned with the specific objectives of this research.

4. Results

4.1 Training Needs of SMEs

A total of 118 SMEs responded to the survey. Most respondents represented one-person businesses (46.6%) and micro-enterprises (46.6%), with a smaller number of small businesses (5.9%) and only a few medium-sized companies (1.7%) included. Most of the respondents (77.9%) were entrepreneurs. In addition, 11% identified as employees, 4.2% as managing directors (CEOs) and 2.5% as managers or supervisors. A further 5.1% selected the "other" category. The businesses covered 15 different sectors, with the most common being other service activities (29.7%), wholesale and retail trade (13.6%), accommodation and food services (12.7%), and human health and social work activities (11.0%). The remaining sectors were each represented by 0.8% to 5.1% of respondents.

The training need most frequently identified by SMEs (see Table 1) was to improve business efficiency with digital tools, which was chosen by 69.5% of respondents. SMEs, therefore, have a clear interest in leveraging digitalisation to improve their operations. Many also identified a need to develop their skills in low-cost or free marketing methods. For example, 64.4% of the respondents highlighted using social media for free promotion, and another 63.6% selected search engine optimisation (SEO), which aims to improve website visibility without

direct advertising costs. On the other hand, search engine marketing (SEM), creation of written content for online use, paid social media advertising and email marketing were reported as training needs by 59–63% of respondents, indicating interest in paid advertising in addition to organic advertising. Notably, 62.7% of respondents indicated interest in learning how to use artificial intelligence in their marketing efforts. Companies are therefore aware of the potential of AI technologies in supporting content production, customer relations and campaign management. Table 1 presents the training needs of SMEs and the distribution of responses.

Table 1: Training Needs of SMEs

Training needs	Theme	Number of Respondents (N=118)	Percentage of Respondents
Enhancing business operations through digital tools	7	82	69.5%
Using social media for free promotion	2	76	64.4%
Search engine optimisation (SEO): Improving website visibility in search engines	4	75	63.6%
Using artificial intelligence (e.g., ChatGPT)	1	74	62.7%
Search engine marketing (SEM) with Google (e.g., Ads and Shopping)	2	74	62.7%
Creating written content for online use (e.g., blogs, articles, social media posts, advertisements)	1	72	61.0%
Paid social media advertising (e.g., Facebook, Instagram, Pinterest, TikTok)	2	70	59.3%
Email marketing: Effective email campaigns	2	70	59.3%
Improving profitability through digitalisation	7	68	57.6%
Monitoring free social media analytics/statistics	3	67	56.8%
Managing the business profile (e.g., appearing in Google search and map services)	4	67	56.8%
Conversion rate optimisation: Modifying a website to generate more contacts, mailing list subscriptions or purchases	5	65	55.1%
Updating website content	4	63	53.4%
Tracking website and e-commerce visitor data (e.g., Google Analytics)	3	62	52.5%
Producing and editing photo and video content	1	61	51.7%
Designing visual materials (e.g., with Canva for social media posts, advertisements, presentations, posters)	1	57	48.3%
Monitoring paid advertising performance (e.g., Google Ads, Meta	3	57	48.3%
Collecting customer feedback (e.g., online surveys)	6	57	48.3%
Data security and privacy (e.g., antivirus protection, privacy policies, cookie consent)	3	53	44.9%
Improving website user experience based on user data	6	49	41.5%
Offering personalised services and recommendations online	6	48	40.7%
Developing digital products/services (e.g., online courses, booking systems)	5	43	40.7%
B2B sales: Business-to-business commerce	5	43	36.4%
Multichannel customer service (phone, email, chat, social media)	6	41	34.7%
Scaling up the business (replicable solutions, e.g., online courses)	7	38	32.2%
Internationalisation through digital channels	7	34	28.8%
Participating in social media discussions	4	33	28.0%
Updating the online store	6	28	23.7%

The training needs least frequently reported by SMEs was related to updating or maintaining an online store. This may be because all sectors, online store is not necessarily a relevant business model. In addition, it appears that only some of the SMEs in South Savo are planning to expand into international markets. Scaling the business through digital tools was also a less frequently selected item. Such growth strategies are therefore not yet on the agenda of many SMEs, even though they could make it possible to grow the business. Participating in social media discussions received little interest as well. This could be interpreted as a sign that most respondents already feel confident in their ability to engage with customers on social media platforms.

Unexpectedly, multichannel customer service was also selected infrequently. One explanation is that many SMEs focus on only certain service channels and may not yet see the value of multiple digital touchpoints. Additionally, limited resources may prevent them from managing several channels effectively.

The responses reveal a gap between basic and more advanced digital skills requirements. SMEs showed broad interest in training topics that support day-to-day business operations, while more complex digital strategies attracted less attention. This suggests that many companies are currently focusing on practical implementation rather than strategic expansion. Therefore, training, and advisory services should be tailored to meet the varying levels of digital skills and capabilities of SMEs.

4.2 Digital Tools and Evolving Competence Needs of Business Advisors

A total of 100 business advisors responded to the national survey. The majority of respondents (53%) worked in regional development or business promotion agencies. Others represented municipal business services (13%), entrepreneurial organisations and business mentors (together 19%), and various rural advisory and support organisations. The survey received responses from 17 of Finland's 19 regions.

The original survey included both quantitative questions and open-ended items. In this study, only selected quantitative responses of the survey are analysed. The survey used questions based on rating scales, and calculating means and medians showed general patterns and supported the comparison of tools. This was done to get an overview of the use of digital tools and competence priorities among business advisors, and to enable comparison with the training needs of SMEs. The survey results provided an overview of how digital technologies are currently utilised in advisory work and what kind of expertise is considered essential now and in the future. Business advisors reported frequent use of basic digital tools in their everyday work. These included email applications, cloud storage and file management systems, video conferencing platforms, and customer relationship management (CRM) systems. In contrast, tools for project management and data analysis were less commonly used. (See Table 2).

Table 2: Use of Digital Tools Among Business Advisors: Frequency of Use by Tool Type

	1 Never	2 Rarely	3 Occasionally	4 Often	5 Daily	Average	Median
CRM system	8.0%	7.0%	9.0%	26.0%	50.0%	4,0	4.0
Project management tools	24.5%	22.5%	29.6%	16.3%	7.1%	2,6	3.0
Video conferencing tools	0.0%	0.0%	8.0%	44.0%	48.0%	4.4	4.0
Cloud services and file management	1.0%	0.0%	5.1%	19.2%	74.7%	4.7	5.0
Email tools	0.0%	0.0%	0.0%	3.0%	97.0%	5.0	5.0
Data analysis tools	16.5%	25.8%	29.9%	18.5%	9.3%	2.8	3.0
Artificial intelligence tools	6.1%	6.1%	25.2%	34.3%	28.3%	3.7	4.0
Artificial intelligence in content creation	15.2%	14.1%	32.3%	30.3%	8.1%	3.0	3.0
E-mail marketing tools	32.3%	23.3%	31.3%	11.1%	2.0%	2.3	2.0
Website management platforms	29.3%	22.2%	18.2%	21.2%	9.1%	2.6	2.0
Graphic design tools	24.3	23.2%	25.3%	23.2%	4.0%	2.6	3.0

Many business advisor used tools based on artificial intelligence relatively often, daily or at least occasionally. However, about 12% reported using AI only rarely or not at all, and the use of AI in content creation was notably less frequent. On average, AI was used for content purposes infrequently, with 30% of respondents reporting that they used it rarely or not at all. Digital marketing tools were not widely used. Some respondents reported using tools such as email marketing platforms, website management systems, and graphic design software occasionally. Among social media channels, Facebook and LinkedIn were the most used platforms, while others were used infrequently or not at all. These figures reflect general usage habits but do not provide information

about the depth or quality of skills. Frequent use may indicate routine familiarity, but not necessarily advanced competence.

These results suggest that while business advisors are generally familiar with basic digital tools, their use of more advanced solutions, such as data analytics, AI content tools, and digital marketing platforms, may be limited. This highlights the need to distinguish between tool use and actual competence, and to strengthen training and organisational support to better equip advisors to assist SMEs in adopting these technologies. Respondents were asked to select between one and five skills they considered most important. When asked to identify the most important digital skills, 60% of business advisors selected the ability to use AI as the most critical skill presently. This skill was considered even more important when looking to the future. The second most important current skill was proficiency in commonly used office software, which also ranked fourth on the list of future skills. Table 3 presents the digital skills that business advisors identified as most important for their work in 2025 and those anticipated to be most critical by 2030. The table includes the top-rated competencies.

Table 3: Key Digital Skills for Business Advisors: Comparison of 2025 and 2030 Priorities

2025		2030	
Skill area	**% of respondents (n=100)**	**Skill area**	**% of respondents (n=98)**
Artificial intelligence	60.0%	Artificial intelligence	70.4%
Office software proficiency	41.0%	Digital customer advisory services	37.8%
Data-driven management	38.0%	Cybersecurity	31.6%
Service design	31.0%	Office software proficiency	28.6%
Digital marketing	30.0%	Data analysis	28.6%
Data protection and information security	29.0%	Data protection and information security	25.5%
Social media competence	29.0%	Data-driven management	24.5%
Digital customer advisory services	24.0%	Media literacy	21.4%
Data analysis	22.0%	Personalised customer experience	19.4%

Other important digital skills in 2025 included data-driven management, service design, digital marketing, and social media competence. Instead, the skills considered most important in 2030 reflect a shift towards more specialised digital skills. In addition to artificial intelligence and office software skills, business advisors emphasised the growing importance of digital customer advisory services, cybersecurity, and data analysis. Data protection and information security also remained particularly important. In addition, new emerging areas were identified. These included media literacy and personalised customer experience. Based on the results, skills are moving from general digital skills to more specialised and even strategic digital skills. Based on this, it can be expected that the role of business advisors will continue to change.

4.3 Comparison and Interpretation of Results

Artificial intelligence (AI) emerged as a top training need among SMEs and was also recognised by business advisors as the most important current and future skill. While AI is becoming more commonly used in advisory work, business advisors may still lack the capacity to support SMEs in applying it effectively in areas such as marketing or content creation. Another important training need for SMEs was digital marketing. However, business advisors used digital marketing tools only occasionally. Still, they identified digital marketing as a critical area of expertise.

SMEs' training needs in data management, analytics and online visibility demonstrate the growing importance of data-driven thinking. Yet, few business advisors were actively engaged in SEO or using data analytics tools, even though they recognised data skills as key future skills. SMEs also showed high interest in using social media for promotion, while advisors mostly relied on a few core platforms. Although some advisors anticipate that social media skills will become less relevant, their basic platform familiarity may suffice for current SME needs. Less than half of SMEs identified data protection as a training need. In contrast, business advisors ranked cybersecurity, data protection and information security as the most important skills for the future. The result

may indicate differences in the sense of urgency or awareness regarding the topic.

Based on the results, there may be a mismatch between the immediate training needs of SMEs and the current use of tools by business advisors. However, there is encouraging consistency in identifying future skills priorities. It is important to strengthen the practical digital skills of business advisors to better meet the needs of SMEs. At the same time, SMEs themselves need to continue developing their digital capabilities to use recent technologies effectively.

5. Discussion and Conclusions

This study examined how well business advisors' current skills and future priorities align with SMEs' digital development needs. The results confirm that SMEs and business advisors have a similar understanding of key digital skills, especially artificial intelligence (AI), digital marketing and data exploitation. However, practical gaps emerge, especially in the use of digital tools related to digital marketing, content production and data analysis. As digitalisation continues, the role of business advisors will continue to evolve. In addition to traditional business guidance, they are increasingly expected to function as facilitators of digital transformation. Their role is to help SMEs effectively implement digital solutions. This shift demands the ability to translate complex digital opportunities into actionable, entrepreneur-oriented support. While business advisors are generally aware of relevant digital skills, their ability to use advanced tools varies.

Survey results also show that many entrepreneurs report a wide range of training needs. With the support of a knowledgeable advisor, these needs could be prioritised and addressed in a more focused and effective way. Advisors who are motivated to improve their digital skills are well placed to help entrepreneurs do the same. In this way, advisory work becomes a learning partnership rather than a one-way delivery of expertise. At the same time, the uneven development of digital competences suggests that a more flexible and collaborative advisory model is needed. Business advisors do not need to master all aspects of digital, but they should be able to identify clients' needs and direct them to appropriate resources and experts. As previous research has shown, the ability to navigate between policy, technology and practical business decision-making is increasingly important (Strilets et al. 2022; Ulas 2019).

To conclude, the findings indicate the need to strengthen both the individual and organisational capacities of business advisors to support SMEs in their digital development. Also, SMEs need to develop their competences. Although business advisors and entrepreneurs often recognise the same areas of competence as important, differences in the use of tools and experience reveal practical gaps that should not be ignored. Bridging these gaps requires training and structural conditions that enable business advisors to apply their digital skills in practice. As the demands of advisory work change, developing more adaptable forms of support is important to ensure that SMEs receive relevant, timely and effective guidance on digitalisation. Based on the findings, three key areas for development are recommended: strengthening business advisors' hands-on training in digital tools, creating clearer pathways for referring SMEs to external digital experts and ensuring sufficient resources for advisors to update their digital knowledge in practice. Further research is needed to explore how digital competence develops over time within advisory organisations and how different support models affect SMEs' digital outcomes. Further examination could provide deeper insight into the conditions that support a sustainable digital transition for SMEs.

Ethics Declaration

Participants in both surveys described in this article accepted the privacy notice, which outlined the intended use of their data.

AI Declaration

Artificial intelligence (ChatGPT) was used to support the writing and editing of this article. The tool was used to refine language, assist with translation, and enhance the overall readability. All content was critically reviewed and approved by the authors.

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Reframing Innovation: Contextualizing Resilient Intrapreneurship and Social Value in Academic Libraries through the FluxLib Model

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Abstract: This study reconceptualizes opportunity recognition (OR)—a core entrepreneurial competency—as a culturally embedded behavior within academic libraries. Drawing on case studies from Malaysia and New Zealand, we explore how librarians practice resilient intrapreneurship—the ability to initiate, adapt, and sustain innovation amid constraints. Using the FluxLib framework, we show that Malaysian librarians anchor innovation in spiritual values and policy alignment, while their New Zealand counterparts rely on intercultural reflexivity and distributed leadership. Despite differing institutional logics, both demonstrate behaviors that generate socially meaningful innovation aligned with the Third Mission of universities. The study advances entrepreneurial competency theory through culturally responsive constructs such as spiritually anchored motivation, curated participation, and empowered vulnerability. We also provide practical pathways for embedding innovation-readiness in resource-constrained, culturally diverse environments. By shifting the focus from individualist, market-oriented entrepreneurship to embedded intrapreneurial behaviors, FluxLib offers a transferable framework for building socially impactful innovation ecosystems in public knowledge institutions. However, the findings are limited to selected institutions and cultural contexts. Future research may test the FluxLib framework across other national settings or apply it in longitudinal studies to examine sustainability over time.

Keywords: Opportunity Recognition, Resilient Intrapreneurship, Entrepreneurial Competencies, Institutional Logics, Fluxlib Framework, Academic Libraries, Librarians

1. Introduction

In an era where knowledge institutions are redefined by rapid technological and societal change, academic libraries are increasingly expected to serve as engines of innovation rather than mere service units. Innovation is integral to global competitiveness, with academic libraries evolving from passive repositories into dynamic hubs of research, education, and knowledge creation (Cox, 2018; Meesad & Mingkhwan, 2024). Digital transformation has further accelerated this shift, reshaping access, user engagement, and knowledge production in higher education contexts (Muslim, 2024). Although entrepreneurial competencies (EC) are well-established in business scholarship, their relevance to academic librarianship remains under-theorized and insufficiently contextualized—particularly concerning how librarians recognize and act upon innovation opportunities (de Jesús Molina Gutiérrez et al., 2023). This paper positions opportunity recognition (OR) as a core dimension of EC, central to institutional innovation in academic library settings.

Although different, the innovation ecosystems in Malaysia and New Zealand remain broadly comparable. Malaysia's policy-driven landscape is shaped by frameworks such as the Economic Transformation Programme and the Higher Education Blueprint 2015–2025, which mandate institutional entrepreneurship (Idris, Sirat, & Da Wan, 2019; Azman, Sirat, & Ahmad, 2014). Academic libraries are thus expected to contribute to rankings and research outputs (Darko Adjei & King, 2024). New Zealand, by contrast, offers a decentralized, bottom-up innovation culture, where librarians are active in interdisciplinary research, entrepreneurship education, and community innovation (Edens & Malecki, 2020; Howie & Kara, 2022). In both contexts, librarians continue to face structural constraints such as limited resources, bureaucratic inertia, and inconsistent leadership support (Chuang, Weng, & Hsieh, 2019; Giesecke, 2012). OR functions as a strategic competency for navigating these constraints and responding to emerging academic demands (Yeh & Walter, 2016; Walton & Webb, 2016).

This comparative case study explores how cognitive, emotional, and contextual factors shape OR among academic librarians in Malaysia and New Zealand. The findings offer empirical and theoretical insights into building innovation-ready library systems, informing policy, leadership, and practice.

This paper is structured as follows: Section 2 reviews the literature, Section 3 outlines the methodology, Section 4 presents the findings, and Section 5 concludes.

2. Literature Review

Within academic librarianship, EC are increasingly significant as libraries transition from traditional service units to innovation-driven hubs (Cox, 2023; Giesecke, 2012). Digital transformation accelerates this shift, reshaping access and knowledge production (Muslim, 2024). In Malaysia, libraries operate within structured, policy-aligned systems (Idris, Sirat & Da Wan, 2019; Azman, Sirat & Ahmad, 2014), whereas New Zealand libraries reflect decentralized innovation cultures (Howie & Kara, 2022). Despite differences, both face common barriers including limited resources and bureaucratic rigidity (Chuang, Weng, & Hsieh, 2019; Pinfield, Cox, & Rutter, 2017; Sultan, 2023; Khoeini et al., 2025). These constraints necessitate adaptive and context-sensitive innovation behavior.

EC refer to cognitive, behavioral, and strategic capacities to identify opportunities, mobilize resources, and drive innovation (Toane & Figueiredo, 2018; Filser, Kraus & Brem, 2023). A core dimension of EC is OR—the ability to perceive gaps and respond with innovation (Baldacchino, 2013; Yeh & Walter, 2016). While EC are well-established in business literature, their application in academic libraries remains under-theorized (de Jesús Molina Gutiérrez et al., 2023). Most EC models emphasize individual traits such as proactivity and adaptability (Keshavarz, 2021; Makinde, Aina & Ajayi, 2023), often underplaying institutional and cultural influences. In public-sector contexts, EC must be reconceptualized as embedded within institutional logics (Kraus et al., 2023; Du et al., 2022). OR, often seen as cognitive, is increasingly viewed as shaped by ethical and cultural dimensions (Sa'ari & Abu, 2025).

Empirical studies reflect varied EC enactments. Nigerian librarians are framed as change agents (Makinde, Aina & Ajayi, 2023). Keshavarz (2021) connects information literacy with innovation, while Edens and Malecki (2020) highlight libraries as interdisciplinary spaces. Yet studies on how librarians enact OR remain limited. De Jesús Molina Gutiérrez et al. (2023) identify libraries' innovation role but offer little behavioral insight. Lembinen (2021) and Cox (2023) emphasize inclusive ecosystems and experimentation, but empirical grounding is thin.

Global EC literature is dominated by Western paradigms. Southeast Asia and the Pacific remain underexplored (Jain & Behera, 2023), with little attention to how EC manifests under different governance or cultural logics. Malaysia and New Zealand offer contrasting yet comparable contexts. This study departs from traditional EC literature, which assumes a linear, discovery-based view of OR (Shane & Venkataraman, 2000), and instead emphasizes interpretive, socially constructed behaviors better explored through qualitative inquiry.

This study challenges traditional EC literature, which often adopts a linear, discovery-based view of OR (Shane & Venkataraman, 2000), by advancing an interpretive, socially embedded perspective better suited to qualitative inquiry. It applies the FluxLib framework (Sa'ari & Abu, 2025)—an empirically grounded model for public-sector knowledge institutions that integrates cognitive, emotional, and ethical dimensions of OR. In contrast to commercially oriented models, it emphasizes relational trust, intrinsic motivation, and identity alignment. Three EC models are compared alongside FluxLib: Shane and Venkataraman (2000), Kraus et al. (2023), Du et al. (2022), and Man (2001).

Table 1: Comparison of Selected EC Models and the FluxLib Framework

Dimension	Shane & Venkataraman (2000) – Opportunity Discovery Model	Kraus et al. (2023); Du et al. (2022) – EC in Constrained Environments	Man (2001) – Competency-Based EC Framework	FluxLib Framework (Sa'ari & Abu, 2025)
Unit of Analysis	Individual entrepreneur	Institutional actors under constraint	SME-level entrepreneurs and knowledge workers	Academic librarians in public-sector institutions
Opportunity Framing	Market discovery; linear, objective	Situational and adaptive	Processual and skills-based	Ethically and culturally constructed; shaped by trust and identity
Contextual Sensitivity	Low; assumes universality	Moderate; acknowledges systemic barriers	Context-aware, but functionally oriented	High; aligned with religious, cultural, and institutional logics
Behavioral Focus	Risk-taking, alertness, innovation intent	Improvisation, adaptability, value-action alignment	Generic managerial skills (e.g., strategy, innovation, leadership)	Resilience, spiritual motivation, intercultural reflexivity

Dimension	Shane & Venkataraman (2000) – Opportunity Discovery Model	Kraus et al. (2023); Du et al. (2022) – EC in Constrained Environments	Man (2001) – Competency-Based EC Framework	FluxLib Framework (Sa'ari & Abu, 2025)
Innovation Logic	Profit and firm creation	Organizational renewal under pressure	Performance enhancement and competitiveness	Social value creation aligned with the Third Mission
Library Sector Relevance	Low	Partial	Limited contextual fit	Purpose-built for constrained, mission-driven knowledge institutions

FluxLib outlines three EC dimensions—Network Leverage, Psychology of Success, and Self-Awareness—as antecedents of OR. It positions OR as emerging through collaboration, resilience, and ethical reflexivity. The model aligns with the university's Third Mission by framing innovation as a societal contribution (Zomer & Benneworth, 2011).

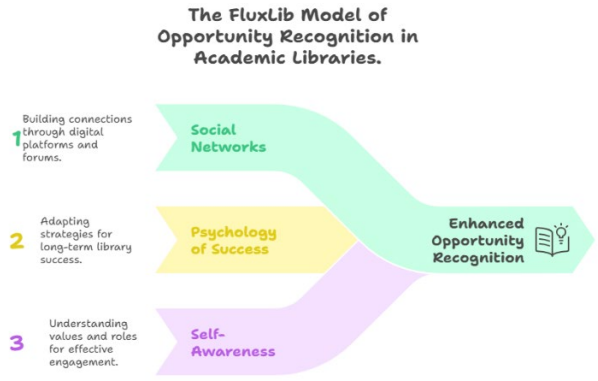


Figure 1: The FluxLib Model of Opportunity Recognition in Academic Libraries. Adapted from Sa'ari & Abu (2025), the model illustrates institutional, cognitive, and ethical drivers of OR.

A critical synthesis of the literature reveals several enduring limitations: (i) an overemphasis on individual entrepreneurial traits; (ii) Insufficient engagement with institutional and cultural context and (iii) A lack of empirical research in public-sector libraries within underrepresented regions such as Southeast Asia and the Pacific. These critiques, echoed by Kraus et al. (2023), Du et al. (2022), and Cox (2023), highlight the need for frameworks like FluxLib. This study, guided by a cross-cultural design, explores how OR functions as a culturally embedded behavior among academic librarians in Malaysia and New Zealand.

3. Methodology

This study investigates how academic librarians in Malaysia and New Zealand demonstrate opportunity recognition (OR) as a core dimension of entrepreneurial competencies (EC), guided by the FluxLib framework (Sa'ari & Abu, 2025). A comparative multiple case study design was employed to examine contextual influences and cross-national variations in the conceptualization and practice of EC. Rooted in an interpretivist paradigm, the study aimed to capture librarians' lived experiences and interpretations of OR and innovation within academic libraries (Creswell & Poth, 2018; Yin, 2018). Purposive sampling was used to recruit twenty-four participants (twelve from each country), comprising academic and chief librarians from public, government-funded universities. Chief librarians were selected based on their strategic roles in institutional innovation and leadership in open research initiatives. Data collection combined semi-structured interviews and focus group discussions (FGDs), allowing for both in-depth personal narratives and collective reflections on innovation practices (Patton, 2015; Kitzinger, 2020). This dual-method approach enhanced data triangulation and thematic richness. All interviews were transcribed verbatim and analyzed using thematic analysis (Braun & Clarke, 2021). Thematic analysis was conducted manually, combining both deductive (guided by the FluxLib framework) and inductive coding. Although no qualitative software was used, themes and subthemes were visually mapped into a hierarchical structure using a manually constructed tree map to enhance interpretive clarity and analytical transparency (Braun & Clarke, 2021; Nowell et al., 2017; Creswell & Poth, 2018). To enhance analytical trustworthiness, all coding decisions were documented through an audit trail, and theme development was discussed and verified among the research team to ensure consistency and reflexivity.

Manual, iterative coding was conducted to identify theoretical patterns and emergent themes linked to OR and EC. The FluxLib model served as an analytical guide, supporting both deductive (theory-informed) and inductive (data-driven) interpretation. Transcripts, memos, and field notes were systematically indexed to ensure transparency and analytical rigor (Creswell & Poth, 2018). Ethical approval was obtained from institutional ethics boards in both countries. Participants gave informed consent, and all data were anonymized and securely stored in accordance with qualitative research standards (Saunders et al., 2019). The integration of cross-case analysis, theory-guided coding, and ethical rigor provides a robust foundation for exploring OR within academic librarianship (Eisenhardt & Graebner, 2021; Yin, 2018).

Table 2: Institutional Profiles of Case A (Malaysia) and Case B (New Zealand): Comparative Overview of University Contexts

Criteria	CASE A (Malaysia)	CASE B (New Zealand)
University ranking QS (Quacquarelli Symonds)) / Type / Location	150–200 / Public / Selangor	250–300 / Public / Wellington
Specialization	Agriculture & Biosciences	Humanities & Social Sciences
Library collection	>600,000 volumes; >80,000 articles	>600,000 volumes; >80,000 articles
Library Staff Strength	80–150	80–150
Chief librarian's minimum experience / Qualification	30 years / Related degree	30 years / Related degree
Academic librarian's minimum experience / Qualification / Age	≥5 years / Related degree / >35	≥5 years / Related degree / >35
Number of participants	5	5

4. Findings and Discussions

This section presents comparative insights from academic librarians in Case A (Malaysia) and Case B (New Zealand), examining how OR—as conceptualized in the FluxLib framework—shapes innovation practices in academic libraries.

4.1 Leveraging Social Networks

Case A librarians displayed relational innovation reflexivity—informal, emotionally grounded engagement with researchers to identify service gaps. "We always sit down informally with the researchers—sometimes just over coffee—to understand what they really need." (Librarian 2, Case A). These trust-based interactions allowed ideas to emerge organically and move quickly from recognition to experimentation. This reflects Cox's (2023) view of libraries as laboratories—spaces where innovation arises through continuous feedback rather than centralized planning.

In contrast, Case B librarians identified opportunities through structured channels, such as working groups and scheduled consultations. "Subject librarians have regular interaction with academics… they're the ones who notice if training needs to shift." (Librarian 1, Case B). Here, curated participation was common—feedback was invited but filtered based on timing and institutional priorities. "We told the staff it wasn't the right time—but left the door open." (Librarian 3, Case B). This supports Giesecke (2012) and Chuang et al. (2019), who emphasize leadership's role in pacing change.

Constraints like limited staffing and introverted team dynamics required careful management. "We can't send people to do things just in case—they need to be strategic" (Librarian 2, Case B). Cultural adaptation also shaped OR: "Coming from a different country, I realized I sometimes miss cues locals would catch." (Librarian 3, Case B). These illustrate procedural trust—reliance on structured processes over informal rapport (Howie & Kara, 2022).

In sum, Case A emphasized informal, horizontal collaboration; Case B practiced structured, filtered engagement. These behaviors extend FluxLib via constructs such as curated participation and procedural trust, underscoring that innovation emerges not only from openness but also from institutional pacing and safeguarded participation. These distinctions matter not only for how OR is enacted, but for how inclusive and sustainable

innovation becomes over time—especially in multicultural or resource-limited library systems.

Table 3: Case-Specific Behaviors in Network Engagement: Emergent Patterns of Opportunity Recognition via Social Capital

Emergent Behavior	Description	Case
Relational innovation reflexivity	Informal, emotionally grounded dialogue to co-discover needs	Case A
Curated participation	Leadership filters staff input based on timing and structural fit	Case B
Procedural trust	Trust in institutional routines to support safe innovation	Case B

4.2 Psychology of Success

In Case A, librarians often linked success to institutional performance targets such as QS rankings and MyRA scores. Entrepreneurial actions were externally motivated, although deeply grounded in ethical and spiritual commitments. "Working in a library is part of my amal jariah," noted one participant, referring to the Islamic notion of ongoing charity (Kahf, 2003; Sadeq, 2002; Sulaiman, 2016). This reflects spiritually anchored motivation, where innovation is framed as both professional duty and spiritual contribution, consistent with Sa'ari, Abu and Adenan's (2023) work on Islamic values shaping librarian identity.

Participants also demonstrated skills-based agency, applying prior academic or industry experience to institutional needs. For example, one librarian leveraged a botany background to resolve backlogs, while another applied stock exchange experience to research support. These cases show how librarians reframed operational gaps as opportunities for meaningful impact—exemplifying a future-oriented, proactive mindset (Filser et al., 2023).

In Case B, innovation was often initiated autonomously, especially during crises. "When the campus shut down, we didn't wait for a directive—we just launched virtual workshops," said one librarian. Others turned funding shortfalls into open access opportunities. These behaviors illustrate adaptive intrapreneurship—a blend of emotional resilience, strategic improvisation, and self-driven learning in decentralized systems (Howie & Kara, 2022).

These findings expand FluxLib with three context-driven constructs: spiritually anchored motivation (Case A), skills-based agency (Case A), and adaptive intrapreneurship (Case B), affirming that OR is shaped not just by cognition but also by emotional, ethical, and experiential factors.

Table 4: Psychological Drivers of Innovation: Behavioral Indicators of Success-Oriented Opportunity Recognition

Emergent Behavior	Description	Case
Resilient intrapreneurship	Self-initiated innovation within structural constraints	Case A & B
Adaptive intrapreneurship	Proactive, emotionally regulated action in uncertain contexts	Case B
Spiritually anchored motivation	Ethical/religious values as innovation drivers	Case A
Skills-based agency	Leveraging past experience for proactive contribution	Case A

4.3 Self-awareness

Self-awareness emerged as a strategic enabler of OR across both cases, shaping how librarians interpreted their roles, engaged with institutional culture, and responded to innovation demands within their socio-cultural settings.

In Case A, self-awareness was framed through ethical and spiritual values such as ikhlas (sincerity), tawadhu' (humility), and amal jariah (ongoing charity). "If I help a scholar complete a grant with better references—that's barakah," noted one participant. This form of spiritually anchored reflexivity fostered intrinsic accountability, where innovation was perceived as both professional contribution and spiritual reward. These findings align with Sa'ari (2018), who observed that Islamic ethics shape librarians' understanding of innovation. Participants also

expressed critical reflexivity, recognizing generational gaps in library education and calling for curricular evolution to meet current demands.

In Case B, self-awareness was developed through intercultural experience, mentorship, and reflective practice. Participants emphasized intercultural reflexivity, shaped by cultural humility and sensitivity to difference. "I've had to adjust how I interpret things… I miss cues locals would catch," shared one librarian. Others described empowered vulnerability, enabled by psychological safety and team support. These behaviors align with literature on inclusive innovation (Lembinen, 2021; Chen & Starosta, 2005; Edmondson, 1999; Edmondson & Lei, 2014; Howie & Kara, 2022) and reinforce the idea that diverse, psychologically safe teams foster innovation (Newman, Donohue, & Eva, 2017; Frazier et al., 2017). Together, these cases show that self-awareness operates as both a psychological anchor and context-sensitive asset.

Table 5: Role of Self-Awareness in Entrepreneurial Behavior: Reflexive Patterns Shaping Innovation Readiness

Emergent Behavior	Description	Case
Spiritually anchored reflexivity	Innovation interpreted through Islamic ethical values	Case A
Intercultural reflexivity	Cultural humility and reflection guiding adaptive action	Case B
Empowered vulnerability	Willingness to express doubt, supported by psychological safety	Case B

4.4 Comparative Behavioral Patterns in OR among Academic Librarians

Although Cases A and B differ institutionally and culturally, both exhibit a shared capacity for context-sensitive, self-initiated innovation. Across both contexts, librarians enacted resilient intrapreneurship—the ability to reframe constraints as innovation opportunities. However, the expressive logic behind this behavior diverged. Case A emphasized informal collaboration, spiritually anchored motivation, and service orientation—reflecting a community-driven innovation logic (Sa'ari & Abu, 2025). In contrast, Case B prioritized structured processes, role-based engagement, and intercultural sensitivity—indicative of distributed governance and psychological safety (Howie & Kara, 2022; Edens & Malecki, 2020).

This divergence reflects behavioral isomorphism—similar outcomes achieved through context-specific strategies (Filser et al., 2023; Pothier, 2019). While Case A leaned on external alignment (e.g., KPIs, religious values), Case B foregrounded internal agency and fluid identity. These contrasts align with research on cultural agility and the role of psychological safety in inclusive intrapreneurship (Szkudlarek et al., 2023; Edmondson & Lei, 2014; Lembinen, 2021).

The table below summarizes these behavioral distinctions and one shared practice: resilient intrapreneurship. These findings refine the FluxLib framework, integrating ethical positioning, adaptive strategy, and relational intelligence—crucial for innovation in public-sector knowledge institutions (Makinde et al., 2023; de Jesús Molina Gutiérrez et al., 2023).

Case A's OR is shaped by religious ethics and institutional conformity, aligning with collectivist logics where innovation serves communal and spiritual aims. By contrast, in New Zealand, opportunity recognition emerges from autonomy-driven systems underpinned by intercultural reflexivity, professional agency, and a strong culture of psychological safety. This duality challenges EC frameworks that assume universal, market-driven motivations. We instead propose a dual mode of OR: one ethically anchored, the other psychologically autonomous.

Table 6: Comparative Synthesis of OR Behaviors in Malaysia and New Zealand: Contextual Differences and Shared Traits

Observed OR Behavior	Case A (Malaysia)	Case B (New Zealand)	Shared Behavior Yes / No
Network engagement	Informal, horizontal collaboration; trust-based dialogue with researchers	Structured, role-mediated communication via leadership and working groups	No
Motivational drivers	External validation (e.g., QS, MyRA); religious-spiritual alignment	Internal drive; professional identity; commitment to service under uncertainty	No
Innovation strategy	Reframing institutional issues through spiritual and service-oriented values	Repurposing constraints through adaptive reflection and self-motivated action	No
Cultural reflexivity	Ethically anchored reflexivity grounded in Islamic principles	Intercultural reflexivity shaped by humility, listening, and psychological safety	No
Leadership role	Minimal leadership filtering; idea flow via informal influence	Strong leadership pacing; curated participation and procedural trust mechanisms	No
Resilient intrapreneurship	Focused on service, moral contribution, and external impact	Focused on adaptability, initiative, and emotional self-regulation	Yes

The comparative synthesis of OR behaviors across both cases is presented in Table 5, highlighting key differences and one shared behavior—resilient intrapreneurship.

These findings extend beyond descriptive contrasts and offer theoretical contributions to the study of EC in public-sector knowledge institutions. In particular, they illustrate that OR is not a universal or purely cognitive process, but one deeply shaped by institutional logics and cultural cognition. In Malaysia, OR is embedded in collectivist logics shaped by religious ethics and hierarchical governance, where innovation is interpreted as communal service and spiritual contribution. In contrast, New Zealand librarians operate within bicultural norms and distributed authority, fostering psychologically safe environments whereby autonomy and intercultural reflexivity guide innovation behavior. These divergent innovation logics challenge dominant EC frameworks that assume individualist, market-oriented behavior. FluxLib's integration of ethical, emotional, and governance-sensitive constructs—such as spiritually anchored motivation and curated participation—offers a culturally responsive model for EC in academic libraries. By theorizing OR as a hybrid process mediated by governance systems (centralized vs. distributed), normative institutions (religious vs. secular), and cultural cognition (collectivist vs. individualist), this study contributes to ongoing debates in institutional entrepreneurship and innovation ecosystems (Thornton, Ocasio & Lounsbury, 2012; Edens & Malecki, 2020).

The findings also reinforce the core of the FluxLib framework: OR in academic librarianship emerges not merely from cognition but through the interplay of values, institutional conditions, and adaptive behavior. By showing how these elements function across contrasting governance systems, the study affirms FluxLib as a culturally transferable framework for intrapreneurial behavior. This offers a foundation for rethinking how institutions cultivate innovation readiness—at both individual and systemic levels (see Figure 2).

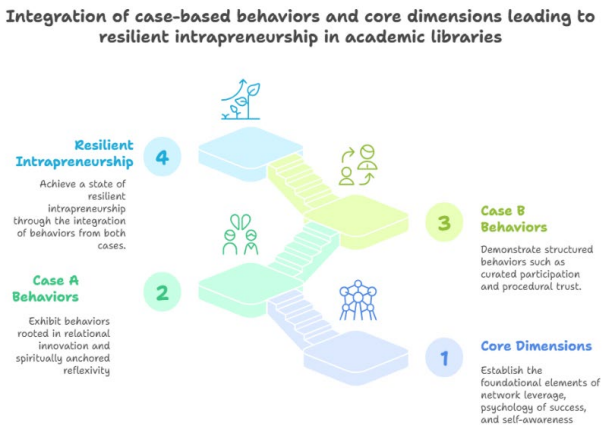


Figure 2: Integration of Case-Based Behaviors and Core Dimensions Leading to Resilient Intrapreneurship in Academic Libraries

Crucially, these findings align with the Third Mission of universities, which refers to the broader societal and economic contributions of higher education institutions beyond teaching and research (Zomer & Benneworth, 2011; Perkmann et al., 2013). By surfacing behavioral mechanisms such as curated participation and spiritually anchored motivation, this study provides a concrete behavioral blueprint for embedding innovation-readiness into academic library systems. These insights can guide leadership development, performance frameworks, and innovation initiatives tailored to diverse cultural settings. Strategically cultivating such competencies empowers libraries to contribute meaningfully to research, knowledge transfer, and community impact—core pillars of the Third Mission.

While the FluxLib model articulates the macro-level integration of entrepreneurial behavior, Figure 3 offers a micro-analytical lens by zooming in on the constituent behavioral variables that underpin resilient intrapreneurship across both national contexts.

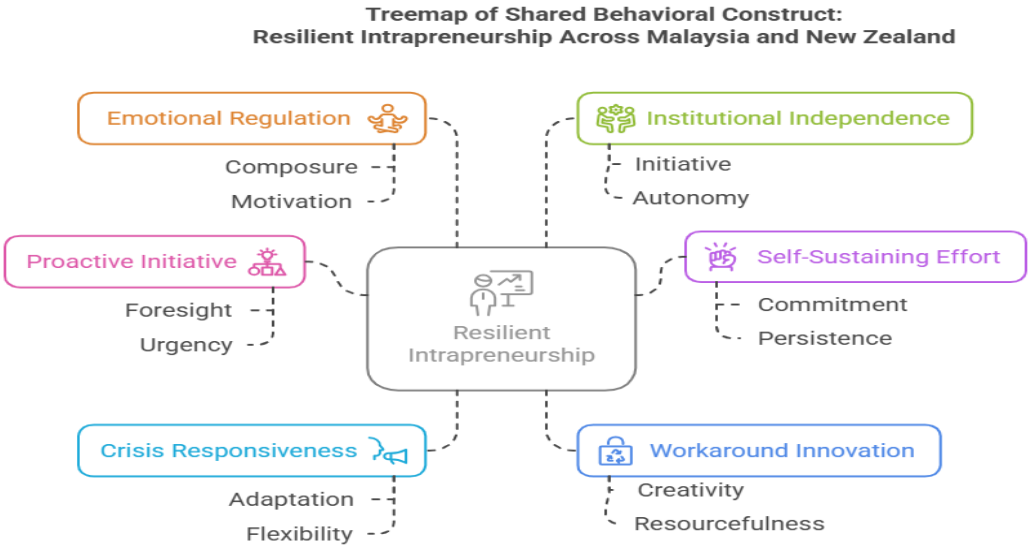


Figure 3: Treemap of Shared Behavioral Construct—Resilient Intrapreneurship Across Malaysia and New Zealand

This treemap visualizes six emergent behavioral variables that underpin the shared construct of resilient intrapreneurship observed across Malaysian and New Zealand academic librarians. These include emotional regulation, proactive initiative, institutional independence, self-sustaining effort, crisis responsiveness, and workaround innovation. Each variable comprises micro-level behaviors that collectively enable librarians to innovate effectively despite structural constraints.

To deepen the analysis of the shared construct, Table 6 details the six behavioral variables that collectively define resilient intrapreneurship, supported by data excerpts from both cases.

Table 7: Emergent Variables of Resilient Intrapreneurship Across Contexts (Shared Construct)

Behavioral Variable	Description	Illustrative Data Excerpt
Proactive initiative	Self-initiated action taken without waiting for formal directives — often grounded in foresight and a sense of urgency.	"I just knew it was time."
Self-sustaining effort	Enduring personal commitment to innovation, even in the absence of recognition, reward, or institutional incentives.	"Keep going because I care."
Crisis responsiveness	Rapid, decisive adaptation during institutional or environmental crises; innovation triggered by disruption.	"We didn't wait—we launched it."
Workaround innovation	Creative repurposing of available resources in response to budgetary or structural limitations.	"Used it to highlight open access."
Emotional regulation	Maintaining composure, clarity, and motivation under pressure — reflecting inner resilience and focus.	"Don't freeze in a crisis."
Institutional independence	Willingness to operate outside formal job scopes or hierarchies when opportunity demands it.	"Even if it's not in my job description (JD), I'll do it."

These six behaviors illuminate how innovation readiness can emerge organically within constrained systems, offering a new vocabulary for public-sector entrepreneurial leadership.

5. Conclusions and Future Directions

This comparative study operationalizes and extends the FluxLib framework, offering theoretical and practical insights into how OR—a core EC—unfolds among academic librarians in Malaysia and New Zealand. The findings demonstrate that OR is not merely a cognitive or individual skill, but a behavioral process embedded in ethical, cultural, and institutional logics. By applying the FluxLib model across two distinct contexts, this study advances EC theory beyond its traditional commercial scope. Librarians in both countries demonstrated resilient intrapreneurship—the capacity to self-initiate, adapt, and creatively repurpose constraints as triggers for innovation. However, the underlying mechanisms diverge, reflecting the mediating power of institutional logics.

This study employed a qualitative, cross-case design involving interviews and focus groups with academic librarians in both countries. This interpretive approach enabled rich insights into how OR behaviors emerge across culturally distinct and structurally constrained environments.

- In Malaysia, OR is shaped by Islamic ethics and a sense of communal duty. Spiritually anchored motivation and a deep-rooted service ethos align with hierarchical governance and national performance imperatives. Librarians' actions are often guided by amal jariah, where professional service is seen as both social and spiritual contribution. This collective ethos fosters trust and loyalty, but may also reinforce deference to authority and incremental innovation.
- In New Zealand, biculturalism and intercultural reflexivity underpin a culture of psychological safety and empowered vulnerability. The Māori–Pākehā partnership promotes humility and mutual respect, enabling librarians to experiment, voice dissent, and reframe challenges. Decentralized governance and autonomy support adaptive intrapreneurship and identity work, with innovation emerging through inclusive learning cultures.

These cultural logics not only provide context but shape the form and function of entrepreneurial behaviors. This enriches institutional logics theory (Thornton, Ocasio, & Lounsbury, 2012) by showing how dominant belief systems and governance structures mediate innovation enactment in public-sector knowledge institutions. Situating OR within innovation ecosystems and institutional entrepreneurship (Kraus et al., 2023; Du et al., 2022), this research highlights that innovation in academic libraries is both organizational and ontological—rooted in worldviews, identity, and relational trust. This reconceptualization affirms that OR is not a universal trait, but a socially embedded construct reflecting ethical and institutional realities. The FluxLib model connects individual competencies with structural conditions, offering a culturally attuned, transferable framework for innovation in diverse higher education systems. FluxLib serves not only as an analytical tool but as a grounded model for understanding EC in public knowledge ecosystems. However, its applicability depends on alignment between institutional logics, governance models, and cultural values. Institutions with strong normative frameworks (e.g., religious-based universities) may resonate more with spiritually anchored constructs, while decentralized cultures may find adaptive intrapreneurship and empowered vulnerability more salient. For library leaders and policymakers, these insights underscore the importance of fostering psychologically safe environments that recognize librarians as emotionally intelligent and strategically positioned actors. Structural reforms alone are insufficient; building innovation-readiness requires cultures that value identity alignment, trust, and ethical reflexivity. The FluxLib model offers practical guidance for aligning innovation strategies with the university's Third Mission and the broader goals of social entrepreneurship and sustainable development. While this study is limited to public universities and a specific timeframe, it opens pathways for future inquiry across private institutions, longitudinal designs, and national innovation systems. Further research should examine how ethnic positionality, language, and indigenous traditions mediate innovation capacity. Comparative studies in other underrepresented regions will enrich the theoretical robustness and practical utility of the FluxLib framework. Conclusively, this paper demonstrates that OR in academic libraries is a culturally and institutionally embedded behavioral process. By extending FluxLib, it provides a nuanced, actionable framework for fostering innovation in knowledge institutions worldwide.

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Key Determinants of Economic Growth in Central and Eastern European Countries in 1995-2019

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Abstract: The single greatest enlargement of the European Union happened in 2004, when ten new countries joined, eight of which were from Central and Eastern Europe, known as CEE. Economic growth matters to all countries, but it is particularly important for those that have recently become members of the European Union. This study aims to research the economic growth of three Central and Eastern European countries: Poland, the Czech Republic and Hungary. Specifically, it investigates the relationship between economic growth and several key determinants, such as Foreign Direct Investment, Inflation, Research and Development and Unemployment. This paper identifies which of these issues are in fact the main determinants of economic growth, especially affecting gross domestic product. Time series annual data are used for the period from 1995 to 2019, OLS regression analysis is carried out for three CEE countries to test variables in each of the selected countries. The choice of the research period results from the reasons regarding the availability of data and the emergence of the global COVID-19 pandemic in 2020, which significantly influenced the international economic situation. The main conclusion is that inflation negatively impacted the economic growth of all three analysed countries. While, it is also noted that Hungarian economic growth was positively impacted by foreign direct investment, and economic growth in the Czech Republic was positively impacted by research and development. Also, in Poland the economic growth was negatively affected by a high rate of unemployment. This study contributes to the existing literature by identifying key determinants of economic growth in CEE countries. This research can be useful for policymakers who can observe CEE countries to see how specific determinants impact economic growth. The motivation to undertake the research resulted from the personal scientific interests of the authors and the revealed cognitive gap.

Keywords: Gross Domestic Product, Foreign Direct Investment, Inflation, Innovation, Research and Development, Unemployment

1. Introduction

For many countries, EU membership has supported economic growth, as noticed in most Central and Eastern European (CEE) states. However, the rise in economic growth across CEE countries has prompted a key question: did initial income levels increase due to higher economic growth, or were other factors responsible? Previous studies suggest that innovation influences research and development (R&D) expenditures, foreign direct investment (FDI), unemployment rate, and technological investment, all of which promote economic growth in CEE countries such as Poland, the Czech Republic, Hungary, the Slovak Republic and Romania Pece et al. (2015), Simionescu et al. (2017).This study focuses on Poland, the Czech Republic and Hungary, as both Bayar and Sasmaz (2019) and Rapacki and Prochniak (2009) argue that the 1990s transition period and the onset of globalisation coincided with high growth rates in CEE countries, and that EU enlargement significantly contributed to the economic growth of the ten CEE countries. This research aims to examine how determinants of economic growth affect Poland, the Czech Republic, and Hungary, and to identify which factors are most influential in each case. Specifically, the aim is to assess the individual impact of these determinants across the three countries. This study employs the Ordinary Least Squares (OLS) regression model using annual data for the period 1995-2019. Accordingly, this research analyses how foreign direct investment (FDI), inflation, research and development (R&D) and unemployment affect gross domestic product in the case of CEE countries. The purpose of this research is to offer a comparative assessment of how these economic determinants shape the growth trajectories of Poland, the Czech Republic, and Hungary.

2. Literature Review

2.1 Key Determinants of Economic Growth

Countries may pursue different growth trajectories. Ignatov (2022) observed that the effectiveness of the transformation through which the economies of Central and Eastern European countries passed varied, which

influenced their economic situation. Bilenko (2024) emphasised that the dominant positive factor influencing the economic growth of the countries in question was the budget balance, while the impact of the exchange rate was relatively weak. Garncarz (2024) identified the positive impact of foreign trade on the economic growth of CEE countries. Tang (2024) highlighted the importance of banking sector efficiency for the economic development in CEE countries. Străchinaru (2023) concluded in his research that indicators such as inflation rates, real interest rates, domestic credit granted to the private sector, current account balances, and government spending have a negative and significant impact on economic growth, while trade openness has a positive impact. Peredy et al. (2022) found that strong domestic demand, foreign direct investment, and the dynamics of world trade have only a limited impact on the development of CEE countries. Petrakos (2008) analysed the determinants of economic growth across countries and regions worldwide. The results indicate that developed countries should focus on human capital, technology, knowledge, and innovation, whereas less developed countries should prioritise the institutional environment, socio-political framework, FDI, openness, and infrastructure. The quality of institutions is a strong reflection of a country's level of economic development. Therefore, well-designed policies can enhance economic growth, human capital, and other key determinants, according to Petrakos (2008). Furthermore, Boldeanu and Constantinescu (2015) argue that the main drivers of economic growth are public expenditure, openness, and FDI. Ioan et al. (2020) investigate the effects of imports, exports, FDI inflow and outflow. Additionally, Mazurek (2017) found that six factors – initial GDP level, economic openness, democracy index, human capital, physical capital, and FDI – are crucial for economic growth. To summarize the literature review, it is necessary to note the existing differences in the approach of individual authors as to the importance of individual factors shaping the economic development of the countries of Central and Eastern Europe. They often blame the differences in the economic transformation paths of individual countries.

2.2 EU Membership and Economic Growth in CEE Countries

According to Bayar and Sasmaz (2019), globalisation intensified in the 1980s, marked by increase in the flow of goods, services, and capital. Developing and emerging economies experienced greater inflows of foreign direct investment (FDI) and foreign loans, which represent an important source of financing for developing countries. Central and Eastern European countries are advised to allocate FDI funds towards productive investments yielding higher returns, to offer incentives for attracting greenfield investments, and to ensure the competitiveness and survival of domestic enterprises in comparison with foreign companies operating in the same sector. EU membership accelerated economic growth in eleven CEE countries between 1995 and 2015 Rapacki and Prochniak (2019). The authors analysed the determinants of economic growth, including the progress of market reforms, economic freedom, foreign aid and FDI inflows. Furthermore, Gilbert and Muchova (2018) analyse changes in export share and export competitiveness following the fifth EU enlargement in 2004, when eight CEE countries joined the EU - the largest single enlargement to date. They found that while export competitiveness increased among CEE countries, the growth in market share was not statistically significant. The authors also examined the impact of EU membership on gross domestic product gross domestic product (GDP) levels. However, it is important to note that EU financial assistance to its poorer members – although the specific mechanisms are not detailed – has contributed to long-term economic growth. EU membership enables greater access to Western European markets. This integration has shifted emphasis from primary exports to industrial exports, which correlates with higher economic growth in developing countries. Still, although exports positively affect economic growth, most developing countries do not distinguish between export types and their respective impacts, as confirmed by Tang (2020). The convergence process is generally faster in less developed countries than in developed economies Glodowska and Pera (2019). Some CEE countries continue to exhibit lower levels of economic development relative to other EU Member States.

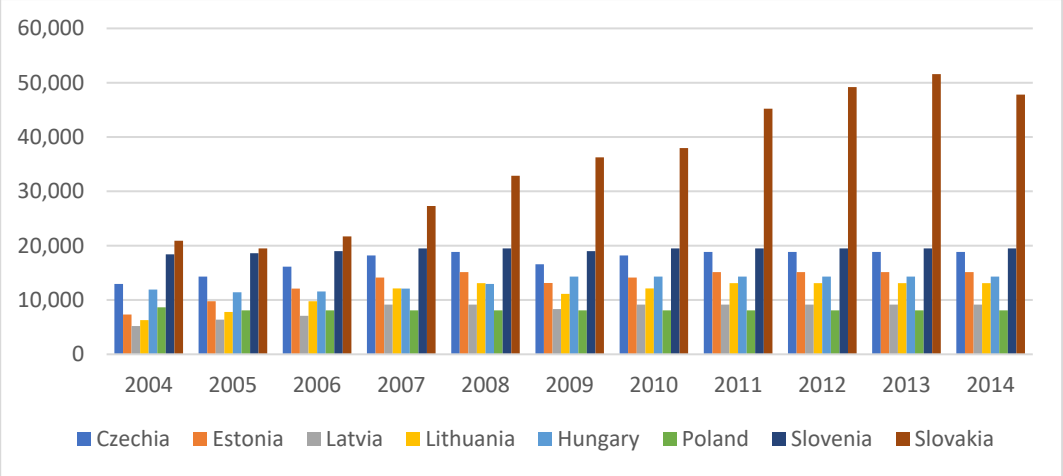
2.3 Determinants of Economic Growth in Selected Countries

An interesting finding by Škare et al. (2019) is that policymakers should consider the structure of bank loans and financial development in relation to economic growth and credit growth. The authors distinguish between the significance of loan types – loans to households versus loans to companies – within the financial sector. The structure of lending was also further analysed by comparing investments in machinery and equipment (associated with business loans) to mortgage loans (associated with households). The comparison of lending thus determines the impact of financial development on economic growth in both short and long term. According to Kołodziejczyk (2016), a decade of EU membership has contributed to increased economic growth and the modernisation of Poland's legal, institutional, economic, political, and social reforms. Poland is currently narrowing the gap with the developed EU Member States, achieving income levels two to three times higher

than the EU average. Structural funds have transformed Poland's road, agricultural, industrial, environmental, and cultural infrastructure. However, a significant challenge remains: Poland ranks low on innovation indicators Global Innovation Index (2025). Improving the situation requires reforms in market research, development, innovation financing, technical capacity, taxation, education, economic activity, and political discipline Chesbrough et al. (2024). Another important issue is the availability of mineral resources. While Poland possesses substantial reserve of hard coal, lignite, copper, zinc, lead ores, rock salt and other raw materials Scheyder (2024), it lacks strategic resources necessary for modern technologies and green energy. Poland must therefore transition away from non-renewable resources and increase reliance on renewable energy. The Czech Republic experienced a temporary recession and rising inflation in the 1990s Koyame-Marsh (2011). The transition period was also marked by increased income inequality. A second wave of reform policies introduced in the mid-1990s led to sustained economic growth, although the 2008 global crisis posed challenges. These policies focuses on GDP growth, inflation control, employment, and income inequality. According to Šlosarčík (2011), post-1990s efforts aimed to integrate the Czech Republic into the EU's internal market. EU membership transformed the Czech Republic's political, economic, and regulatory environment. Obešlo (2017) noted that trade—particularly import and export of goods—is a critical contributor to the country's economic growth. Among the most influential variables in import analysis were real exports and real effective exchange rates deflated by the PPI index. While real import growth has short-term benefits, it does not sustain long-term growth. Since joining the EU, the Czech Republic—a small, open economy in the centre of Europe—has seen a substantial increase in international trade. Exports and imports constitute a significant share of Czech GDP. According to the Global Innovation Index, the Czech Republic exhibits the highest level of innovation among the three countries discussed, nearing the EU average. This can be attributed to cyclical R&D expenditure, a high level of education, and a strong focus on knowledge-based production and innovative technologies. The Czech Republic also holds important mineral resources such as uranium, gold, tin, graphite, and kaolin, which are considered the most valuable among the three countries in terms of their role in economic development. Torrisi (2015) argued that the size of the domestic market in smaller economies like Hungary may be less relevant to foreign investors. Instead, wage levels, trade openness, and economic liberalisation are key in attracting FDI. According to Matolcsy and Palotai (2019), Hungary has achieved significant economic progress by reducing unemployment, increasing employment, improving its budget balance, lowering public debt, and restoring external balance. The employment rate and wage levels in Hungary are now in line with the EU average. Higher household incomes have stimulated both consumption and savings. Although strong economic growth continued until 2013, Hungary remains financially stable Matolcsy and Palotai (2019). The government reformed its tax system to improve both employment and public finances, with support from the Central Bank. According to Pinter (2018), EU membership has influenced Hungary's economy through increased foreign trade and capital flows. Hegedüs and Kiss (2014) examined the impact of EU membership on Hungary's agricultural trade with the 27 EU Member States, noting a decade of consistent growth from 2003 to 2013. The EU market remains essential for Hungarian exports, accounting for 80% of total exports. Hungary ranks between Poland and the Czech Republic in terms of innovation, as indicated by the Global Innovation Index. While Hungary possesses mineral resources such as bauxite, oil, natural gas, and various industrial raw materials, these resources play a relatively minor role in its economic development.

3. Data and Methodology

The data selected for this study were obtained from Eurostat and the World Bank. The variables included in the model are gross domestic product (GDP), foreign direct investment (FDI), inflation, research and development (R&D), and unemployment. Annual data were collected for 25 years, covering the period from 1995 to 2019, and analysed for Poland, the Czech Republic, and Hungary. The year 1995 was selected as the starting point because it is the earliest year for which complete data are available. The year 2019 was chosen as the final year of analysis primarily due to the COVID-19 pandemic, which lasted from 11 March 2020 to 5 May 2023, according to the World Health Organisation. Furthermore, the inclusion of data during the pandemic could have altered the actual results, as the economic indicators for the years 2020, 2021, and 2022 were likely affected by exceptional circumstances and were therefore excluded from the study. Graph 1 illustrates the GDP per capita of CCE countries and period, reflecting economic output on a per-person basis. It is observed that Slovenia and Slovakia consistently had the highest GDP per capita values, whereas Latvia and Lithuania exhibited the lowest throughout the period. Fluctuations in GDP per capita are visible, particularly during the years affected by the global financial crisis of 2008–2009. Graph 1 presents GDP per Capita of CEE countries for the period 2004–2014.



Figuer 1: GDP per Capita of CEE countries, 2004–2014 (in USD)

Source(s): Author's own creation based on Eurostat data

In this research, the following four hypotheses were developed:

H1: Foreign direct investment (FDI) has a statistically significant impact on gross domestic product (GDP) in Poland, the Czech Republic, and Hungary.

H2: Inflation has a statistically significant impact on GDP in Poland, the Czech Republic, and Hungary.

H3: Research and development (R&D) has a statistically significant impact on GDP in Poland, the Czech Republic, and Hungary.

H4: Unemployment has a statistically significant impact on GPD in Poland, the Czech Republic, and Hungary.

The Ordinary Least Squares (OLS) regression model is used in this study, based on annual time series data. OLS minimises the sum of the squares of the residuals, where residuals represent the difference between the actual observed values and the values estimated by the model. Regression analysis is applied in this article to examine how four independent variables influence GDP. This study shares similarities with the model developed by Pece et al. (2015), in which the authors conducted an empirical analysis of economic growth in Poland, the Czech Republic, and Hungary. Their research tested the relationship between economic growth and key determinants for each country during the period 2000–2013**.** The OLS model in this study includes one dependent variable (GDP) and four independent variables: foreign direct investment (FDI), inflation, research and development (R&D), and unemployment. The period under analysis spans 1995-2019. The regression model is specified as follows: log (GDP) = a + β1 (FDI) + β2 (INF) + β3 (R&D) + β4 (UEM) + ε where: GDP = Gross Domestic Product (million euro, current prices), FDI = Foreign Direct Investment (% of GDP), INF = Inflation rate (annual %), R&D = Research and Development (% of GDP), UEM = Unemployment rate (annual %) and ε = error term.

3.1 Key Variables

The dependent variable in this study is GDP for Poland, the Czech Republic, and Hungary. GDP data were collected annually from Eurostat and are measured in million euros at current market prices. The first independent variable is foreign direct investment, measured in net inflows (% of GDP), with data collected annually from World Bank. The second independent variable is inflation, based on consumer prices (annual %), also obtained from World Bank. The third independent variable is research and development for all sectors, expressed as a percentage of GDP, with annual data sourced from Eurostat. The fourth independent variable is unemployment, measured as the percentage of the total labour force, collected annually from World Bank. Several academic studies have examined economic growth in CEE countries, with a particular focus on Poland, the Czech Republic, and Hungary. Pece et al. (2015) included these three countries in their analysis of economic growth during the period 2000–2013, using GDP, R&D, FDI, and unemployment as explanatory variables. In contrast, Simionescu et al. (2017) extended their analysis to include Romania, covering the years 2003–2016. Similarly, (Petrariu et al. (2013) examined economic growth across CEE countries, with a research period spanning 1996–2010.

3.2 Descriptive Statistics

Summary statistics for Poland, the Czech Republic, and Hungary are presented in three separate tables and were calculated using EViews.

Table 1: Summary statistics for Poland

Specify	GDP	FDI	Inflation	R&D	Unemployment
Mean	12.515	3.348	5.303	0.751	11.337
Median	12.657	3.153	2.581	0.660	10.090
Maximum	13.187	6.231	27.951	1.320	19.900
Minimum	11.598	0.153	-0.874	0.540	3.280
Std. Dev.	0.466	1.368	6.823	0.218	4.909
Observations	25	25	25	25	25

Source: The author's own calculation

Table 2: Summary statistics for the Czech Republic

Specify	GDP	FDI	Inflation	R&D	Unemployment
Mean	11.643	4.945	3.357	1.374	5.908
Median	11.842	4.517	2.451	1.230	6.660
Maximum	12.326	10.337	10.698	1.960	8.760
Minimum	10.737	0.904	0.119	0.880	2.010
Std. Dev.	0.486	2.660	2.983	0.364	1.986
Observations	25	25	25	25	25

Source: The author's own calculation

Table 3: Summary statistics for Hungary

Specify	GDP	FDI	Inflation	R&D	Unemployment
Mean	11.301	10.731	7.214	1.038	7.551
Median	11.458	7.049	4.856	0.980	7.410
Maximum	11.892	56.361	28.305	1.510	11.170
Minimum	10.476	-40.291	-0.228	0.630	3.420
Std. Dev.	0.423	21.929	7.087	0,269	2.344
Observations	25	25	25	25	25

Source: The author's own calculation

The mean GDP for Poland is 12.515, which is higher than that of the Czech Republic (11.643) and Hungary (11.301). This difference is primarily attributed to Poland's larger economy, whereas the Czech Republic and Hungary have similar GDP levels. The standard deviations for GDP across the three countries show minimal variation, indicating that all three experienced stable economic growth over the period 1995–2019. In terms of FDI as a percentage of GDP, there are substantial differences in the maximum and minimum values across the countries. Hungary recorded the highest maximum value at 56.361, suggesting a strong reliance on FDI. However, the minimum value for Hungary is –40.291, which may indicate efforts to reduce FDI dependency or large disinvestments during certain periods. The FDI values for Poland and the Czech Republic were less extreme. In Poland, the maximum FDI value was 6.231 and the minimum 0.153, suggesting that Poland was the least dependent on FDI among the three countries. The Czech Republic recorded a maximum FDI of 10.337 and a

minimum of 0.904, positioning it between the other two. Inflation data indicate that Hungary had the highest average inflation rate, at 7.214, followed by Poland (5.303) and the Czech Republic (3.357). This range of 3% to 7% reflects a relatively high inflation rate across the period. In terms of inflation volatility, the Czech Republic had the lowest standard deviation (2.983), indicating more stable inflation. In contrast, Hungary and Poland experienced greater fluctuations, with standard deviations of 7.087 and 6.823, respectively. These higher values suggest that inflation exerted a greater impact on GDP in these two countries. Research and development (R&D) is a key factor for economies in transition. However, R&D expenditure remains relatively low in all three countries. The Czech Republic recorded the highest maximum R&D value, reaching 1.960, which indicates a comparatively stronger emphasis on innovation. In terms of unemployment, Poland had the highest maximum rate at 19.900, followed by Hungary at 11.170, and the Czech Republic at 8.760. The lowest recorded unemployment rates were 3.280% in Poland, 2.010 in the Czech Republic, and 3.420 in Hungary. These figures suggest that all three countries have made notable progress in reducing unemployment, which may be partly attributed to increased FDI inflows associated with EU membership. Despite receiving substantial FDI, all three countries report relatively low R&D values and have historically faced high unemployment levels. A comparison of the mean and median values reveals that in Poland, inflation data show slightly larger deviations, while the Czech Republic presents the most consistent results, with the smallest differences between mean and median values. In Hungary, however, the situation is more variable: the mean FDI is 10.731, compared to a median of 7.049; and the mean inflation is 7.214, while the median is 4.856, suggesting a right-skewed distribution for both variables.

3.3 Correlation Analysis

Multicollinearity in the regression model may pose a problem when the independent variables are strongly correlated with one another. In such cases, standard errors tend to increase, which can affect the precision of the estimated coefficients, even though the overall reliability of the model may appear unchanged. This issue can result in variables appearing statistically significant when they are not, or conversely, masking significance where it exists. Tables 4, 5, and 6 present the correlation matrices for the variables included in the model, allowing for an assessment of potential multicollinearity.

Table 4: Correlation matrix for Poland

Specify	FDI	Inflation	R&D	Unemployment
FDI	1***	--	--	--
Inflation	-0.040	1***	--	--
R&D	-0.367*	-0.318	1***	--
Unemployment	0.189	0.175	-0.769	1***

Source: The author's own calculation

Table 5: Correlation matrix for the Czech Republic

Specify	FDI	Inflation	R&D	Unemployment
FDI	1***	--	--	--
Inflation	-0.059	1***	--	--
R&D	-0.328	-0.572	1***	--
Unemployment	0.441**	-0.262	-0.372*	1***

Source: The author's own calculation

Table 6: Correlation matrix for Hungary

Specify	FDI	Inflation	R&D	Unemployment
FDI	1***	--	--	--
Inflation	-0.013	1***	--	--

Specify	FDI	Inflation	R&D	Unemployment
R&D	-0.110	-0.756	1***	--
Unemployment	-0.145	0.366*	-0.255	1***

Source: The author's own calculation

There is evidence of collinearity among the independent variables, particularly in the cases of Hungary and Poland; however, this does not represent a serious issue requiring corrective measures. In this study, if any variable exhibits a correlation coefficient of 0.85 or higher, it will be substituted with an alternative variable to mitigate the potential effects of multicollinearity.

4. Results

The OLS model consists of three separate regressions, based on 75 observations drawn from Poland, the Czech Republic, and Hungary over a 25-year period (1995–2019). Variables exhibiting correlation coefficients greater than 0.77 were excluded from the analysis to minimise the risk of multicollinearity. The results of the OLS estimations are presented in Table 7, based on outputs generated using EViews software.

Table 7: Empirical results

Variable	Poland's GDP	Czech Republic's GDP	Hungary's GDP
Constant	12.998*	11.157*	10.503*
	(0.348)	(0.540)	(0.223)
FDI	-0.022*	-0.002*	0.003**
	(0.026)	(0.021)	(0.001)
Inflation	-0.045***	-0.065**	-0.026***
	(0.005)	(0.026)	(0.006)
R&D	0.355*	0.736***	0.918***
	(0.263)	(0.222)	(0.160)
Unemployment	-0.039***	-0.050*	-0.001*
	(0.010)	(0.034)	(0.013)
Adjusted R-squared	0.886	0.763	0.897
F-statistic	47.483***	20.269***	53.477***
Total number of observations	25	25	25

Note: Standard errors are in parentheses. *, **, *** Significant at 10%, 5% and 1% respectively.

Source: The author's own calculation

Based on the results presented in Table 7, the following hypotheses can be summarised as follows:

H1: This hypothesis is partially confirmed, indicating that foreign direct investment (FDI) has a positive and statistically significant impact on gross domestic product (GDP) in Hungary only. In contrast, FDI does not have a significant effect on GDP in Poland or the Czech Republic.

H2: This hypothesis is confirmed, showing that inflation has a negative and statistically significant impact on GDP in all three countries—Poland, the Czech Republic, and Hungary. This implies that lower inflation rates are associated with higher levels of GDP.

H3: This hypothesis is partially confirmed, as research and development (R&D) exerts a positive and statistically significant influence on GDP in the Czech Republic and Hungary. However, R&D does not have a statistically significant impact on GDP in Poland.

H4: This hypothesis is partially confirmed, indicating that unemployment has a negative and statistically significant impact on GDP in Poland. This suggests that a lower unemployment rate contributes to higher GDP. However, unemployment does not have a significant effect on GDP in the Czech Republic or Hungary.

4.1 Poland

Inflation and unemployment have a significant negative impact on GDP in Poland, particularly in the context of economic growth. While inflation is often associated with economic booms that may temporarily boost GDP, it can also lead to macroeconomic instability when it exceeds sustainable levels. As such, inflation serves as a key indicator of broader economic dynamics. Daniela et al.(2014) used monthly data from 1996 to 2012 to analyse the effects on inflation in the Czech Republic, Poland, Hungary, Romania, and Turkey, concluding that inflation can generate production uncertainty and reduce overall welfare. These findings align with the present study, which also explores the relationship between inflation, GDP, and welfare. Given that GDP is closely linked to national welfare, a decline in GDP caused by inflation implies a corresponding reduction in societal well-being. The longer time frame covered by this study further strengthens the conclusion that inflation exerts a significant negative influence on Poland's GDP. This is empirically supported by the estimated coefficient of –0.045, which confirms the negative impact of inflation during the selected period. In addition, Kliber (2021) focuses on the impact of unemployment using Okun's coefficient. Although this is a different methodological approach, the findings support the existence of both positive and negative effects of unemployment on GDP in the Polish context. Since the 1990s, Poland has undergone a major economic transformation, yet certain regions continue to suffer from persistently high unemployment rates. A one-percentage-point increase in economic growth has been shown to reduce the unemployment rate by a range of 0.0 to 0.46 percentage points, depending on the region. In particular, agricultural regions in Poland face higher structural unemployment. This has important implications for economic policymakers, who must prioritise regional employment strategies to address this persistent challenge. The regression result for unemployment in this study –0.039, reinforces earlier findings and confirms that unemployment has a negative and statistically significant effect on GDP in Poland, consistent with previous literature.

4.2 The Czech Republic

The Czech Republic is negatively affected by inflation, as confirmed by Daniela et al. (2014) and consistent with the findings of this study. Inflation in the Czech Republic is higher than in Poland, reinforcing its negative influence on GDP. On the other hand, research and development (R&D) in the Czech Republic has a positive and statistically significant impact on GDP, highlighting the importance of innovation-driven growth in the country. Simionescu et al. (2017) sought to identify and examine the determinants of economic growth in five countries - the Czech Republic, Slovakia, Hungary, Poland, and Romania – during the period 2003-2016. Their findings indicate a positive correlated between R&D and economic growth in Romania, Hungary, and the Czech Republic. Nevertheless, the authors stress the need for policy measures aimed at strengthening the R&D sector, in order to support long-term sustainable growth. Similarly, Pece et al. (2015) explored the relationship between GDP and R&D over a shorter time frame (2000 -2013) for Poland, the Czech Republic, and Hungary. Their model focused on three variables – the number of patents, the number of trademarks, and R&D expenditure – to evaluate their impact on economic growth. The results suggest that education, labour force participation, and investment levels are key drivers that contribute to increase R&D capacity to levels conductive to economic development.

4.3 Hungary

In the case of Hungary, the impact of FDI on GDP is positive, and it is more pronounced than in Poland and the Czech Republic, according to the results of this study. Simionescu et al. (2017) also found that FDI supported economic growth in Hungary during the period 2003-2016. However, for FDI to have a lasting and effective influence on economic development, an attractive economic environment, productive investment opportunities, and the capacity to absorb foreign capital are essential. Furthermore, knowledge transfer and technological progress positively influence the effectiveness of FDI, as noted by Pece et al. (2015). Inflation in Hungary is found to have a statistically significant negative impact on GDP in this study, a result that is consistent with the findings of Daniela et al. (2014). Conversely, R&D has a positive and significant effect on Hungary's economic growth. This finding is further supported by the results of Simionescu et al. (2017), who report a similar relationship between R&D and GDP in Hungary.

5. Conclusions

This study examined economic growth in Poland, the Czech Republic, and Hungary during a period of 25 years (1995–2019), describing a longer time frame than many previous studies. The research specifically considered the period following the accession of these countries to the European Union, highlighting the associated economic benefits. The results are country-specific, reflecting unique economic dynamics in each case. Inflation was found to have a negative impact on economic growth in all three CEE countries. Research and development (R&D) had a positive and statistically significant effect on economic growth in the Czech Republic and Hungary, while foreign direct investment (FDI) contributed positively to Hungary's economic performance. Unemployment had the most pronounced negative impact on Poland's GDP, compared to the other two countries. In the case of Poland and Hungary, the findings suggest a need to intensify efforts to enhance innovation, which is a key driver of sustainable economic growth. Overall, the study concluded that FDI, inflation, R&D, and unemployment each exert either a positive or negative influence on economic growth across the three countries. One notable limitation of the study is the exclusion of data beyond 2019, due to the onset of the COVID-19 pandemic in 2020, which lasted until 2023. The years 2020 to 2023 were omitted because of the extraordinary and unpredictable nature of the pandemic, which caused substantial fluctuations in economic activity across Europe. Excluding this period ensured that the analysis was not distorted by external shocks beyond policymakers' control. Other significant methodological constraints are marked differences in the population and size of the economies of individual countries, as well as the changing economic situation. It is recommended that future studies incorporate data covering both the pandemic years (2020–2023) and the post-pandemic period (from 2024 onwards), enabling a comparative assessment of economic recovery. Such research could help determine which countries have been more successful in navigating the crisis and returning to stable growth trajectories.

Ethics Declaration

The authors declare that no ethical nclearence was required for the research.

AI Declaration

The autors declare that no AI tools were used the creation of the paper.

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Exploring Montenegro's Entrepreneurship: Connecting Structural Support and Entrepreneurial Intentions

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Abstract: Entrepreneurship is a critical driver of economic development in emerging economies like Montenegro. However, structural challenges, including fragmented access to funding, bureaucratic inefficiencies, and uneven entrepreneurial education, continue to hinder small business growth. Prior studies using Ajzen's Theory of Planned Behavior (TPB) and the Global Entrepreneurship Monitor (GEM) framework have predominantly focused on student samples. While valuable, such studies often overlook real-world barriers non-student entrepreneurs face, such as regulatory burdens, informal financing, and post-launch instability. This gap is especially relevant in Montenegro, where structural inefficiencies remain underexamined yet heavily impact entrepreneurial action. This study evaluates Montenegro's entrepreneurial ecosystem by integrating structural factors (government policy, funding, and entrepreneurial education) and personal motivations (attitudes, social norms, perceived behavioural control) through the TPB and GEM frameworks. Public awareness is examined as a factor linking institutional support to entrepreneurial outcomes. A survey of 189 Montenegrin citizens—sampled through non-student random and convenience methods—was used to test the hypotheses on the relationships embedded in the study's model that connects structural factors and the TPB. The paper's findings validate its model in that perceived behavioural control (H2), personal attitudes (H1), and subjective norms (H3) significantly influence entrepreneurial intentions. Additionally, structural elements—public policy (H5), entrepreneurial education (H4), and financing options (H6)—significantly influence perceived behavioural control, personal attitudes, and subjective norms, respectively. Public awareness also emerged as an important mediating factor; respondents already engaged in entrepreneurship reported greater familiarity with available resources, correlating with stronger entrepreneurial intentions. The validated model suggests that Montenegro has a bright entrepreneurial future if it can address deficiencies in structural factors. Limitations include a modest sample size and reliance on self-reported data within a geographically limited population, which may affect generalizability. Future research should expand demographic diversity, apply longitudinal designs, and incorporate mixed methods to validate results. This study contributes to understanding entrepreneurship in developing contexts by demonstrating how structural and psychological factors interact. Practical implications include launching targeted awareness campaigns, improving policy communication, and embedding entrepreneurship education in curricula.

Keywords: Entrepreneurial Intentions; Entrepreneurial Ecosystem**;** GEM Framework**;** Theory of Planned Behaviour (TPB)

1. Introduction

The relationship between entrepreneurship and economic development is complex, as entrepreneurship can contribute to both economic growth and structural transformation (Naude, 2013), especially in developing countries like Montenegro (Khyareh and Zamani, 2022). This research examines entrepreneurship in Montenegro and its associated environment. Using Ajzen's (1991) Theory of Planned Behavior (TPB) and the Global Entrepreneurship Monitor (GEM) framework (GEM, 2015), this research analyzes two key entrepreneurship dimensions. By combining structural factors, including the business environment with an emphasis on financing options, public policies, and the role of entrepreneurial education in shaping business opportunities, with personal perspectives, such as personal attitudes, social norms, and perceived control, this paper examines Montenegrins' entrepreneurial experiences. Prior studies applying the TPB to entrepreneurial intentions have predominantly relied on student samples while this study surveys the general population. While student sample studies provide foundational insights, they risk oversimplifying the interplay between structural conditions and individual motivations. This research fills a regional gap by applying the TPB-GEM framework to a non-student, Balkan population, a context often overlooked in global entrepreneurship studies.

2. Theory of Planned Behavior Directed at Entrepreneurship

Ajzen's (1991) TPB is a foundational model for understanding entrepreneurial intentions. It suggests that three factors determine an individual's likelihood to start a business: Personal Attitudes (PA): Personal evaluations of entrepreneurship's benefits and risks. For example, someone who views entrepreneurship as a path to financial independence is more likely to pursue it (Kobylinska, 2022), Subjective Norms (SN): Perceived social expectations from family, peers, or cultural groups. In societies where entrepreneurship is discredited, individuals may avoid

starting businesses despite having the skills (Vamvaka et al., 2020) and Perceived Behavioral Control (PBC): Confidence in overcoming challenges, such as navigating the business environment or complying with public policies. This factor is closely tied to self-efficacy and access to resources (Ajzen, 1991). The TPB emphasizes that intentions are the strongest predictor of entrepreneurial behaviour. Numerous researchers have validated the use of the TPB (Lavelle, 2019; Kautonen, van Gelderen and Tornikoski, 2011; Walker, Jeger and Kopecki, 2013).

3. Structural Factors in Entrepreneurship

3.1 Public Policies

Supportive public policies, such as simplified regulations, reduce barriers to entrepreneurship (Hill et al, 2024). Simplified tax procedures (Waseem, Rashid and Akbar, 2021) and regulatory simplicity (Desembrianita, Zahruddin and Arifin, 2023; Geric and Katanec, 2024) reduce administrative burdens, directly enhancing entrepreneurs' confidence. These challenges are particularly important in developing economies where administrative inefficiencies often set back small business growth (Urban and Ratsimanetrimanana, 2019). Policy design alone is insufficient, as implementation and communication matter equally. In China, vocational students exposed to compulsory entrepreneurship education reported higher PA, yet their low awareness of entrepreneurial resources limited perceived control (Lavelle, 2019). Other studies found that a lack of awareness of public policies limits entrepreneurs' ability to utilize available resources (Slomski et al., 2024; Desembrianita, Zahruddin and Arifin, 2023). Handiman et al. (2022) noted that policy communication is critical; even well-designed initiatives fail if entrepreneurs lack awareness.

3.2 Entrepreneurial Education

The role of entrepreneurial education equips individuals with practical skills and theoretical knowledge (Geric and Katanec, 2024). The same research noted that students who completed entrepreneurship courses were 30% more likely to express start-up intentions. Meta-analytic review confirms a small but significant correlation between entrepreneurship education and intentions, though this effect is stronger when education emphasizes venture creation over theoretical business planning (Bae et al., 2014). Handiman et al. (2022) emphasized that curricula focusing on practical skills are more likely to foster intentions than theoretical approaches. The role of entrepreneurship in economic transformation is particularly evident in regions where structural barriers are addressed through targeted educational policies and institutional reforms (Naude, 2013). Slomski et al. (2024) found that nations with integrated entrepreneurship curricula in schools reported higher student engagement in start-ups, stressing the role of entrepreneurial education in fostering cultural shifts.

3.3 Financing Options

The business environment is a cornerstone of entrepreneurial ecosystems (Isenberg, 2011). In developing regions, limited access to formal loans forces reliance on informal networks which often lack flexibility (Urban and Ratsimanetrimanana, 2019). Geric and Katanec (2024) found that 60% of students rated their knowledge of funding sources as "low," highlighting systemic gaps in the business environment. Solutions like microloans, crowd funding platforms, and public policy-backed grants can democratize access, particularly for sectors like hospitality, which often require moderate initial investments (Saberi and Hamdan, 2018).

4. Montenegro's Entrepreneurial Context

Montenegro's entrepreneurial environment, as reported in the GEM 2010 Global Report (Kelley, Bosma and Amoros, 2011), highlights structural challenges and opportunities. Notably, Montenegro had a Total Early-Stage Entrepreneurial Activity (TEA) rate of 14.9%, higher than neighbouring Eastern European countries. Conversely, only 38% of entrepreneurs reported accessing formal loans, relying instead on personal savings (Kelley, Bosma and Amoros, 2011). Historically, young Montenegrins have been encouraged to seek stable employment in the public or private sectors rather than pursue entrepreneurship, a trend rooted in cultural preferences for job security. Despite this, there has been a gradual shift with youth increasingly viewing entrepreneurship as a viable path to independence. Case studies reveal that family and peer support (SN) play a critical role in overcoming cultural scepticism. Notably, 83% of surveyed youth entrepreneurs cited familial encouragement as pivotal to their decision to start businesses, though broader societal acceptance remains limited (Karadzic, Drobnjak and Reyhani, 2015). Structural challenges persist, particularly in access to finance and administrative complexity. One study found that 33% of young entrepreneurs identify "slow and complicated procedures and high taxes"

as the most significant barrier (Biznis Mladih, 2019), reinforcing GEM's emphasis on institutional conditions within entrepreneurial ecosystems. These bureaucratic hurdles directly undermine PBC.

5. Conceptual Model and Hypotheses

Kobylinska (2022) provides a robust framework for understanding how structural factors interact with personal motivations to shape entrepreneurial intentions, aligning with Lihua's (2022) extended TPB model. Both studies demonstrated that structural variables indirectly influence intentions by reinforcing individual-level factors. This framework (Figure 1) is used to analyse entrepreneurial activity in Montenegro.

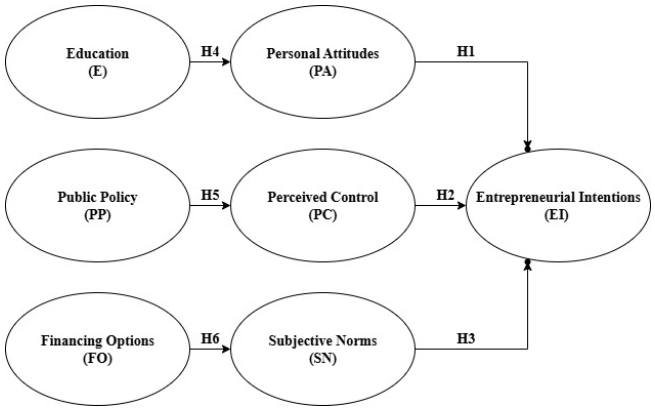


Figure 1: Model adapted from Kobylinska (2022)

H1: PA influences entrepreneurial intentions in Montenegro. Empirical studies confirm that individuals who view entrepreneurship as desirable and feasible exhibit stronger intentions to start businesses (Kobylinska, 2022; Lavelle, 2019). Individuals who perceive entrepreneurship as a viable path to economic stability are more likely to pursue ventures despite structural barriers (Vamvaka et al., 2020).

H2: PBC influences entrepreneurial intentions in Montenegro. PBC, reflecting confidence in overcoming challenges like navigating regulations, directly impacts entrepreneurial intentions (Ajzen, 1991; Kautonen, van Gelderen and Tornikoski, 2011). Structural conditions, such as simplified public policies, enhance PBC by reducing perceived obstacles (Urban and Ratsimanetrimanana, 2019). In regions with administrative inefficiencies or gaps in policy awareness (Geric and Katanec, 2024), weak institutional support may undermine PBC.

H3: SN influences entrepreneurial intentions in Montenegro. Subjective norms shape entrepreneurial intentions by signalling cultural acceptance of entrepreneurship (Ajzen, 1991). Community-driven initiatives supporting small businesses can indirectly strengthen social validation (Lihua, 2022). Stigmas around business failure or societal preference for traditional employment could suppress intentions, highlighting the need for campaigns to shift cultural narratives (Sebayang et al., 2024).

H4: Entrepreneurial education positively influences attitudes toward entrepreneurship in Montenegro. Lihua (2022) emphasized that education is a situational factor favourably shaping PA. Handiman et al. (2022) demonstrated that entrepreneurship education strengthens attitudes toward entrepreneurship by improving students' theoretical and practical knowledge, aligning with Kobylinska's (2022) findings on Polish students. Integrating entrepreneurship into curricula could similarly shift attitudes, especially in the hospitality sector, where practical skills like hospitality management and customer service are critical (Slomski et al., 2024).

H5: Supportive public policies positively influence PBC in Montenegro. Kobylinska (2022) demonstrated that policies reducing bureaucratic complexity directly enhance PBC, a finding mirrored in Lihua's (2022) model, which positions policy accessibility as a key situational factor. This aligns with findings from Waseem, Rashid and Akbar (2021), who emphasize that government initiatives, such as simplified tax policies, directly enhance individuals' confidence in navigating structural barriers.

H6: A supportive funding system positively influences subjective norms toward entrepreneurship in Montenegro. Kobylinska (2022) observed that available financing options indirectly strengthen social acceptance of entrepreneurship. This aligns with Lihua's (2022) argument that community-driven initiatives can enhance cultural perceptions of entrepreneurship. In Montenegro, cultural perceptions of entrepreneurship,

such as community support for small hotels or agrotourism, could enhance subjective norms, encouraging individuals to pursue ventures despite structural challenges (Kelley, Bosma and Amoros, 2011).

6. Methods

6.1 Purpose

While the GEM 2010 (Kelley, Bosma and Amoros, 2011) report provides foundational insights into Montenegro's entrepreneurial environment, over a decade has passed, and structural conditions may have evolved. This study uses the TPB and GEM frameworks to offer an updated perspective on how structural factors interact with personal motivations to shape entrepreneurship in Montenegro. While many previous entrepreneurship studies have focused heavily on students, this research surveys the general public, including active entrepreneurs, to better understand how personal drive and barriers shape real-world Montenegro's entrepreneurial challenges.

6.2 Participants

This study employed a combination of random and convenience sampling methods to recruit respondents. Table 1 provides a demographic description of the189 individuals who completed the survey.

Table 1: Demographics summary

Category	Option	Count	Percentage
Gender	Male	115	61%
	Female	74	39%
Age	< 18	3	2%
	18 – 24	75	40%
	25 – 34	68	36%
	35 -44	26	14%
	45 – 54	13	7%
	55 – 64	3	2%
	65+	1	1%
Residence region	Podgorica	30	16%
	Coastal region	142	75%
	Northern region	10	5%
	Central region	7	4%
Entrepreneurial experience	Yes	60	32%
	No	129	68%

6.3 Instrument

The instrument measured TPB and GEM constructs. To ensure validity and reliability, established scales from prior studies were adapted to the Montenegrin context. The PA and Intentions scales were based on Linan and Chen (2009), while the PBC and SN scales drew from Alin and Dil (2022). Structural Support measures were adapted from the 2011 GEM National Expert Survey (GEM, 2011). All items used a five-point Likert scale (1 = "Strongly disagree" to 5 = "Strongly agree"). PA included five items, such as "A career as an entrepreneur would be attractive to me" and "Being an entrepreneur implies more advantages." PBC was assessed through six items measuring confidence in entrepreneurial abilities, including "To start a business and keep it working would be easy for me" and "I know the necessary practical details to start a firm." SN was measured by three items, e.g., "In Montenegro, most people consider starting a business to be a good career choice." Structural Support was assessed across three subscales: Public Policies (7 items), Financing Options (3 items), and Entrepreneurial Education (4 items). Entrepreneurial intentions were measured with five items, including "My professional goal is to be an entrepreneur" and "I will make every effort to start and maintain my own business."

7. Results and Discussion

Descriptive statistics summarized the characteristics of all constructs. Hypotheses were tested using regression analyses to determine their statistical significance. The analysis of survey responses across seven distinct scales revealed notable variations in participants' perceptions and attitudes toward entrepreneurship. Each scale's results are detailed in Figure 2 and Table 2, with means, standard deviations, and response distributions calculated for the full sample and, where applicable, for a subgroup that excludes individuals already engaged in entrepreneurial activities (EA).

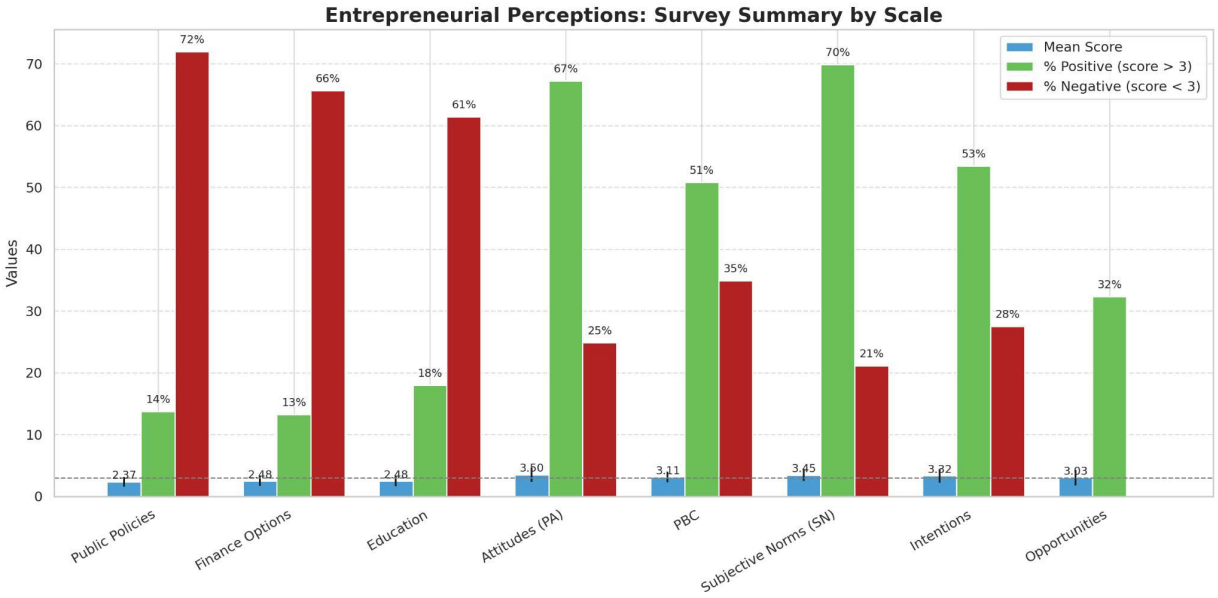


Figure 2: Scale results summary

As a final step, this study determined Montenegro's GEM defined TEA (percentage of the population that has started and run a business for less than 3.5 years) to be 19.05%, comparing favourably with the GEM 2010 value of 14.9% (Kelley, Bosma and Amoros, 2011). While this improvement is promising on the surface, it is noted that this study's sample was over-weighted in age groups that typically produce the most entrepreneurially activity, 18 – 34 (GEM, 2021).

7.1 Public Policies

According to Figure 2, the mean Public Policies score (2.37, SD = 0.78) reflects general disagreement with the effectiveness of government support. Only 13.76% of respondents rated policies positively (mean > 3), while 71.96% disagreed. Among non-entrepreneurs, agreement dropped to 8.99%. The item "New businesses in Montenegro can get most of the necessary permits and licenses within about one week" scored lowest (mean = 1.99), underscoring concerns over bureaucratic inefficiency.

Table 2: Scale results summary ("EA" = entrepreneurial activity)

Scale	Mean (SD)	% Positive (mean > 3)	% Negative (mean < 3)
Public policies	2.37 (0.78)	13.76% (↓ to 8.99% w/o EA)	71.96% (↓ to 48.68% w/o EA
Finance Options	2.48 (0.77)	13.23% (↓ to 6.88% w/o EA)*	65.61% (↓ to 46.56% w/o EA)
Entrepreneurial Education	2.48 (0.85)	17.99% (↓ to 12.70% w/o EA)	61.38% (↓ to 40.74% w/o EA)
PA	3.50 (1.13)	67.20%	24.87%
PBC	3.11 (0.85)	50.79%	34.92%
SN	3.45 (0.99)	69.84%	21.16%
Intentions	3.32 (1.12)	53.44% (↓ to 30.69% w/o EA)**	27.51%

* significant at p = 0.01

**significant at $p < 0.001$

7.2 Finance Options

Figure 2 illustrates perceptions of financial support mechanisms yielded a mean score of 2.48 (SD = 0.77), indicating moderate scepticism about the accessibility and adequacy of financing. A small proportion (13.23%) rated available financing options positively (mean > 3), compared to 65.61% who rated them negatively (mean < 3). Among non-entrepreneurs, positive evaluations fell to 6.88%, while 46.56% expressed dissatisfaction (Table 2). A t-test analysis revealed a significant difference (p = 0.0106) between entrepreneurs and non-entrepreneurs, with entrepreneurs viewing financing options more positively. This suggests that engaging in entrepreneurship increases awareness of available financing options.

7.3 Entrepreneurial Education

Figure 2 indicates, the Entrepreneurial Education scale had a mean of 2.48 (SD = 0.85). While 17.99% of respondents agreed that current educational initiatives support entrepreneurial skills development (mean > 3), 61.38% disagreed (mean < 3). Excluding entrepreneurs, agreement dropped to 12.70%; however, a *t*-test analysis showed no significant difference between the groups (Table 2). A key indicator, "In Montenegro, teaching in primary and secondary schools pays adequate attention to entrepreneurship and the establishment of companies," received the lowest item mean across all education-related questions (mean = 1.88; SD = 0.85), highlighting a perceived lack of early-stage entrepreneurial training in the national curriculum.

7.4 Personal Attitudes

Figure 2 shows attitudes toward entrepreneurship were notably positive, with a mean of 3.50 (SD = 1.13). A majority (67.20%) expressed favourable views (mean > 3), while only 24.87% held negative perceptions (mean < 3). This scale demonstrated the highest overall agreement, reflecting strong personal interest and perceived desirability of entrepreneurial pursuits, despite systemic challenges in other domains.

7.5 Perceived Behavioural Control

As seen in Figure 2, PBC presented a neutral-to-positive mean of 3.11 (SD = 0.85), with 50.79% of respondents confident in their ability to start and sustain a business (mean > 3), and 34.92% expressing doubt (mean < 3). However, a critical item— "To start a business and keep it working would be easy for me"—received a much lower mean (2.53; SD = 0.84), highlighting specific concerns about self-efficacy among the broader population.

7.6 Subjective Norms

Figure 2 shows SN surrounding entrepreneurship were generally perceived as supportive, with an overall mean of 3.45 (SD = 0.99). Nearly 69.84% of respondents reported societal or familial encouragement (mean > 3), while only 21.16% perceived discouragement (mean < 3). Notably, responses revealed a meaningful divergence between general and personal reference groups. Two general statements regarding SN yielded lower means of 3.04 and 3.30, whereas items referring to personal approval—such as support from family and friends—received significantly higher ratings, with means of 3.73, 3.72, and 3.50 respectively. This distinction suggests that while respondents' opinions of Montenegro's overall SN support may be more neutral or inconsistent, individual networks tend to offer strong encouragement, reinforcing entrepreneurship as a socially accepted personal pursuit.

7.7 Intentions

Entrepreneurial intentions had a mean of 3.32 (SD = 1.12), with 53.44% of respondents indicating strong intent to pursue entrepreneurship (mean > 3), while 27.51% showed reluctance (mean < 3). Intentions were disproportionately higher among current entrepreneurs, and when they were excluded from the analysis (*t*-test), agreement dropped significantly ($p < 0.001$) to 30.69%, suggesting that practical experience and the resulting awareness plays a role in shaping entrepreneurial commitment.

7.8 Model Validation

Regression analyses examined relationships between model elements and their influence on intentions.

H1: PA and Entrepreneurial Intentions. PA (Table 3) strongly predicted entrepreneurial intentions ($\beta = 0.52$, $p < 0.001$), representing the largest effect size among all predictors. This underscores that individuals with positive attitudes toward entrepreneurship were substantially more likely to express intentions to pursue it. The result aligns with prior studies emphasizing attitude as the central driver of entrepreneurial motivation (Lavelle, 2019; Kobylinska, 2022).

H2: PBC and Intentions. PBC (Table 3) had a strong, significant relationship with intentions ($\beta = 0.48$, $p < 0.001$). This reinforces Ajzen's (1991) argument that confidence in overcoming challenges (e.g., navigating regulations) is critical for translating intentions into action. The finding also supports Kautonen, van Gelderen and Tornikoski's (2011) conclusion that PBC mediates structural barriers, such as bureaucratic complexity, by enhancing self-efficacy (Urban and Ratsimanetrimanana, 2019).

H3: SN and Intentions. Subjective norms demonstrated a moderate yet significant association with intentions ($\beta = 0.24$, $p < 0.001$). While weaker than PA or PBC, this confirms that perceived social validation (e.g., familial encouragement and cultural acceptance of entrepreneurship) contributes to intent. However, the smaller effect size suggests that internal motivations (attitudes, self-efficacy) outweigh external pressures in driving entrepreneurial commitment (Kobylinska, 2022).

H4: Education and PA. Education demonstrated a weak but marginally significant positive association with personal attitudes ($\beta = 0.12$, $p = 0.065$). While the effect size was modest, it supports Kobylinska's (2022) observation that entrepreneurship education fosters favourable attitudes, particularly when curricula emphasize practical skills over theoretical knowledge (Bae et al., 2014). The marginal significance implies that educational interventions may require targeted design—such as mentorship programs or experiential learning—to meaningfully shift attitudes (Handiman et al., 2022).

H5: Public Policies and PBC. Perceptions of public policies showed a weak yet statistically significant positive relationship with PBC ($\beta = 0.15$, $p = 0.040$). This aligns with Ajzen's (1991) assertion that policy accessibility (e.g., simplified regulations) reduces perceived barriers, thereby enhancing confidence. However, the limited effect size underscores the importance of policy awareness; even supportive policies may fail to strengthen PBC if entrepreneurs lack knowledge of their existence (Geric and Katanec, 2024).

H6: Financial Support and SN. Access to financial options exhibited a moderate, significant effect on subjective norms ($\beta = 0.28$, $p = 0.004$). This supports the GEM framework's emphasis on structural enablers like funding systems which not only provide resources but also signal societal validation of entrepreneurship (GEM, 2015). For instance, microloan programs or crowd funding platforms can enhance communal encouragement by democratizing access to capital (Saberi and Hamdan, 2018).

The validation of this study's model confirms the dual role of TPB constructs (H1–H3) and structural GEM factors (H4–H6) in shaping entrepreneurial intentions. PA (H1) and PBC (H2) dominate as direct predictors, while SN (H3) plays a secondary role. Structural factors, education (H4), public policies (H5), and financing options (H6), indirectly strengthen intentions by reinforcing individual-level motivations. These findings align with Isenberg's (2011) ecosystem framework, advocating for holistic strategies that integrate institutional reforms with programs targeting individual readiness.

Table 3: Model's Standardized Regression Results

Hypothesis	Predictor	Outcome	Beta	*p*-value
H1	PA	Intentions	0.52	<0.001
H2	PBC	Intentions	0.48	<0.001
H3	SN	Intentions	0.24	<0.001
H4	Education	PA	0.12	0.065
H5	Public polices	PBC	0.15	0.040
H6	Finance options	SN	0.28	0.004

8. Conclusion

This study presents encouraging signs for Montenegro's entrepreneurial future. Despite weakly supportive structural factors, Montenegro's TEA is strong. Given the validation of this study's model, it follows that Montenegro's entrepreneurship has room to grow once structural factors are improved; for example, by

launching targeted awareness campaigns, improving policy communication, and embedding entrepreneurship education in curricula. This would create a supportive ecosystem and amplify the population's inherent entrepreneurial drive. This study found that awareness matters as entrepreneurs have significantly more positive responses to financing and intentions resulting from their exposure to entrepreneurship and the corresponding increased awareness of its workings.

Public policies play a dual role: they directly shape perceptions of control and indirectly influence intentions by reducing bureaucratic barriers. The weak but significant link between policies and PBC suggests that streamlining regulations or enhancing policy visibility could bolster confidence in navigating administrative challenges. For instance, clearer communication of tax incentives or licensing procedures may mitigate the scepticism reflected in low policy ratings, enabling more individuals to act on their intentions.

Financing options emerged as a key driver of subjective norms, indicating that accessible funding not only provides resources but also fosters social validation. Expanding formal financial mechanisms, such as microloans or grants tailored to start-ups, would likely strengthen community encouragement, particularly in regions where informal networks dominate. This shift could reduce reliance on personal savings while normalizing entrepreneurship as a culturally supported endeavour.

Entrepreneurial education holds untapped potential. Current dissatisfaction with educational support stems from a perceived emphasis on theory over practice. Reforms prioritizing hands-on training could strengthen both attitudes and PBC by equipping individuals with actionable skills. Education that demystifies start-up processes, from securing permits to managing risks, would empower aspiring entrepreneurs to navigate systemic barriers, amplifying the strong existing intentions.

This research's validated model underscores Montenegro's unique position as a Balkan economy where individual resilience compensates for structural gaps. While the population's high attitudes and intentions reflect a culture of entrepreneurial optimism, systemic improvements are critical to sustaining this momentum. By addressing policy accessibility, financial inclusivity, and educational relevance, Montenegro can leverage its latent potential, fostering a generation of entrepreneurs.

9. Research Limitations

This study has limitations that should be acknowledged. First, the cross-sectional design limits establishing causality between structural inputs and entrepreneurial intentions. While the model identifies associations, longitudinal data would be required to confirm how changes in inputs influence outcomes over time. Second, the sample size, though diverse, may not fully represent Montenegro's entrepreneurial population, particularly given the underrepresentation of northern regions. Third, self-reported measures of perceptions and intentions introduce potential response bias, as participants may overstate socially desirable answers. Finally, the focus on three structural inputs excludes other potential factors, such as cultural narratives, which could also shape entrepreneurial motivations. These limitations highlight the need for cautious interpretation of the results.

10. Ethical Considerations

The study adhered to ethical research practices, including informed consent, voluntary participation, and confidentiality. Ethical protocols were strictly followed, including secure data storage, anonymization of responses, and compliance with institutional review board guidelines. Approval was obtained from the relevant ethics committee at the Rochester Institute of Technology. Participants were assured that their data would be used solely for research purposes and stored securely to prevent unauthorized access. Any identifying information was removed before analysis to protect anonymity.

AI Declaration

Artificial intelligence tools were used in the preparation of this work. The **Consensus** app was utilized to find supportive academic sources and to help evaluate and refine the hypothesis. **Grammarly** was used for the final grammar and language check. All outputs generated or supported by AI tools were critically reviewed and verified by the author to ensure their relevance, accuracy, and alignment with academic standards.

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Social Entrepreneurship as a Catalyst for Reducing Urban Inequalities: Challenges and Opportunities in Montijo, Portugal

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Abstract: Social entrepreneurship has stood out as a promising approach to addressing socio-economic vulnerabilities in urban contexts. This study explores the main structural challenges and opportunities for social entrepreneurship in the parishes of Montijo and Afonsoeiro, Portugal. Using a qualitative approach based on focus groups with local stakeholders, including civil society representatives, social entrepreneurs, associations, and government entities, the research identifies key barriers such as limited access to economic opportunities, social exclusion, and inadequate infrastructure. The findings reveal the transformative potential of socially oriented entrepreneurial initiatives, particularly when supported by strong and collaborative local networks. This work contributes to the understanding of urban vulnerabilities and highlights the importance of supportive ecosystems in promoting inclusive and sustainable development. The insights generated are relevant for policymakers, social entrepreneurs, and civil society organizations committed to fostering social innovation in similar urban settings.

Keywords: Social Entrepreneurship; Socioeconomic Inequality; Local Development; Urban Communities; Support Ecosystems.

1. Introduction

The social problems that affect urban territories continue to require responses that go beyond traditional public policy solutions. Among these responses, social entrepreneurship has been gaining ground, due to its ability to involve different actors and mobilize local resources around collective objectives. This article seeks to analyze the role of social entrepreneurship in urban regeneration and in the promotion of inclusion, based on the empirical study carried out in the Union of Parishes of Montijo and Afonsoeiro. From a perspective guided by the concepts of ecosystem and social innovation, it is proposed to understand how these territories can constitute a favorable environment for the emergence and consolidation of community-based initiatives.

2. Literature Review

Social entrepreneurship has been assuming a prominent place in academic and political discourse and is increasingly recognized as an effective way to address complex social problems and promote structural transformations (Trabskaia et al., 2023). This field encompasses organizations that seek to generate both social and economic value, playing a relevant role in promoting prosperity and responding to societal challenges, especially in contexts marked by instability and crisis (Trabskaia et al., 2023).

The consolidation of social entrepreneurship as a research area has been notorious, with a special focus on its impact in urban contexts and its connection to social innovation (Angelidou and Mora, 2020; Audretsch et al., 2022). This form of entrepreneurship is distinguished by a mission focused on creating social value and a problem-solving approach (Marshall and Jang, 2020). Authors such as Philip Roundy, R. During, K. Mehta and M. S. Ramírez-Montoya stand out for their scientific production and relevant contributions to the development of this field (Trabskaia et al., 2023). Even so, the literature has highlighted different strands and approaches, many of them focused on vulnerable populations and specific territorial contexts.

Among these approaches, the study of how social entrepreneurship promotes the inclusion of vulnerable groups stands out. Kiss et al. (2022), for example, look at the work of social enterprises with marginalized populations, such as the Roma community (commonly known as "Gypsies" or "cigányok") and people with disabilities, in Hungary. The authors show that these organizations are involved in the provision of essential services, in the

dynamization of community support networks and in the promotion of professional integration. These efforts illustrate the potential of social entrepreneurship to mitigate inequalities and strengthen social cohesion and equity (Kiss et al., 2022; Marshall and Jang, 2020; Micelli et al., 2023).

Another relevant contribution is related to the role of social entrepreneurship in the sustainable development of cities. Marshall and Jang (2020) point out that these initiatives contribute not only to job creation, but also to direct support for vulnerable groups, promoting practices aligned with corporate social responsibility and socio-environmental progress. This perspective reinforces the idea that social entrepreneurship has an impact that goes beyond the immediate response to social problems, positively influencing the resilience and sustainability of urban communities.

In parallel, the concept of entrepreneurial ecosystem has gained prominence as an analytical tool to understand the external factors that shape entrepreneurial activity (Audretsch et al., 2022; Cantner et al., 2020; Xu and Dobson, 2019). This approach goes beyond the individual analysis of the entrepreneur, privileging the understanding of the networks of actors, institutions and dynamics that, together, create conditions for the flourishing of entrepreneurial initiatives (Angelidou and Mora, 2020). Despite its initial application in contexts of technological innovation, to explain systems that promote high-growth companies, the need to develop ecosystem models more adjusted to the specificities of social entrepreneurship has been recognized (Angelidou and Mora, 2020; Audretsch et al., 2022).

In this context, the concept of social entrepreneurship ecosystem (SEE) gains prominence, whose definition is still evolving. Trabskaia et al. (2023) underlines that SEEs are a different reality from other types of business ecosystems, given the profile of their actors, their collaboration dynamics and the type of impact they seek to generate. The characterization and delimitation of these ecosystems requires, therefore, a more systematic theoretical and empirical deepening.

Recent research has also been broadening the geographical focus of ecosystem analysis, privileging more circumscribed regional and local contexts, such as cities, peripheral areas and economically fragile territories, where social challenges are manifested with particular intensity (Audretsch et al., 2022; Barki et al., 2020). These territories tend to have structural weaknesses such as unemployment, low qualification, social exclusion, poor articulation with labor markets, and housing precariousness (Barki et al., 2020; Xu and Dobson, 2019). The study carried out in the Union of Parishes of Montijo and Afonsoeiro contributes to this line of research, by offering a detailed diagnosis of local vulnerabilities in a specific urban context. This contribution consolidates the understanding of how contextual factors shape the environment for social entrepreneurship (Barki et al., 2020; Micelli et al., 2023; Xu and Dobson, 2019).

In these scenarios, social entrepreneurship has been pointed out as an innovative response adapted to local needs (Barki et al., 2020; Trabskaia et al., 2023). Its decentralized nature rooted in communities allows it to generate more appropriate and participatory solutions, especially when a bottom-up innovation logic is promoted (Angelidou and Mora, 2020). According to the authors, these solutions generated from the bottom up tend to be more equitable, responsive and aligned with the needs of citizens, gaining greater social and economic impact. Scaffidi et al. (2025) highlight the role of these entrepreneurs in sustainable urban regeneration, showing how, through coworking spaces, cultural centres, social housing and educational programmes, they contribute to revitalising neglected urban areas and promoting social cohesion. These initiatives not only boost the local economy, but also favor inclusion, citizen participation and the sustainable development of the territories.

Even so, the success of social entrepreneurship depends on the existence of a support ecosystem that enhances its development. The literature has been clear in pointing out that the absence of resources, whether economic, human or institutional, compromises the sustainability of the initiatives (Audretsch et al., 2022; Barki et al., 2020). Therefore, it is essential to ensure an articulated set of support factors, which includes financing, adequate public policies, infrastructure, support networks, training, and entrepreneurial culture (Audretsch et al., 2022; Micelli et al., 2023). The systemic vision proposed by ecosystem models reinforces that investment must be directed to all structures and interactions, and not just to entrepreneurs, otherwise a fragmented and ineffective logic will be perpetuated.

One of the aspects often emphasized in the literature concerns the importance of collaboration between the different actors in the ecosystem (Barki et al., 2020; Scaffidi et al., 2025; Trabskaia et al., 2023). The case of Montijo and Afonsoeiro reinforces this idea, by showing that the creation of local and regional collaborative networks is crucial to find sustainable and integrated responses. This cooperative dynamic between civil society,

the public sector, the private sector and intermediate organizations has been pointed out as one of the pillars of the SEE. It is a collective process, which requires coordination, sharing of objectives and mutual strengthening of capacities (Barki et al., 2020; Trabskaia et al., 2023).

This joint work between the different stakeholders is particularly relevant in urban regeneration processes, where the complexity of the challenges imposes a multisectoral and integrated approach. Social entrepreneurs, by collaborating with municipalities, local associations, companies and citizens in the community, can mobilize resources and legitimize their interventions, increasing the impact of their actions. The ability to build trust, manage conflict and promote a shared vision is identified as a critical factor for the long-term success of regeneration initiatives (Scaffidi et al., 2025).

Barki et al. (2020) reinforce this understanding by analyzing the role of intermediary organizations, which work as a bridge between entrepreneurs and available resources. Through a multilevel approach, the authors demonstrate that effective action in vulnerable territories depends on the existence of mechanisms that articulate different scales, promote interorganizational learning networks and consolidate social capital. The figure of the "ecosystem manager" emerges here as a central element in the coordination of actions and in the creation of a favorable environment for entrepreneurship.

In a complementary way, Scaffidi et al. (2025) analyze cases of urban regeneration led by social entrepreneurs with a focus on heritage. The study shows that these actors can play a transformative role, if they are inserted in robust ecosystems, capable of ensuring continued support, articulation between sectors and favorable structural conditions. The recommendations point to the need to build solid collaborative networks and establish public-private partnerships that sustain regeneration processes over time.

In summary, the literature on social entrepreneurship in an urban context point to its growing relevance in promoting social inclusion, sustainability and revitalization of vulnerable territories. Studies such as those by Marshall and Jang (2020) and Kiss et al. (2022) help to theoretically frame these dynamics, while contributions such as those by Barki et al. (2020) and Scaffidi et al. (2025) offer robust empirical evidence on the factors that condition the success of initiatives. The construction of supportive ecosystems, based on collaboration, trust and shared vision, thus emerges as an essential condition for social entrepreneurship to realize its transformative potential.

3. Methods

This study adopted a qualitative research design to explore the ecosystem of social entrepreneurship in the urban-peripheral parishes of Montijo and Afonsoeiro, conceptualized as an adaptive and complex system shaped by the dynamic interaction of multiple actors and institutional logics. The empirical component was conducted between June 2023 and September 2024 and involved the organization of six focus groups, each corresponding to one of the six analytical pillars proposed by Audretsch et al. (2022) and based on Isenberg's framework: Market, Human Capital, Culture, Institutional Support, Finance, and Public Policies.

The focus groups followed a purposive sampling strategy, designed to ensure a diverse and contextually relevant sample of stakeholders with knowledge of the local territory. In total, 36 participants were involved across the six sessions. While individual identities were protected through strict confidentiality protocols, participants represented a range of stakeholder profiles, including: public sector representatives from municipal and regional institutions; entrepreneurs and social entrepreneurs operating in the territory; leaders of civic and community associations; professionals from business incubators and support programmes; cultural and educational agents; academia; civically engaged residents with strong community ties.

Each focus group lasted approximately 1 hour and 20 minutes, and was guided by a semi-structured thematic script, aligned with the respective analytical pillar. The scripts were informed by the conceptual contributions of Isenberg (2011), Audretsch et al. (2022), and Pinto et al. (2021), allowing both comparability with existing models and the emergence of context-specific insights. Sessions were moderated by experienced qualitative researchers, who fostered a dialogical and reflexive environment conducive to the sharing of grounded knowledge.

All sessions were audio-recorded and transcribed precisely, with the informed consent of participants and strict adherence to research ethics principles. No personal identifiers were collected, and participants were informed of their right to withdraw at any time. Anonymity was guaranteed through the use of generic labels in the transcripts.

For data analysis, a systematic qualitative content analysis was employed, involving iterative coding and thematic categorization of the transcribed data. This method enabled the identification of recurrent patterns and key thematic dimensions, capturing both explicit and latent meanings within participant narratives. The results offer an empirically grounded and nuanced understanding of the factors that enable or constrain social entrepreneurship and urban regeneration in Montijo and Afonsoeiro.

This methodological approach enabled the construction of a robust empirical basis for assessing the enabling and constraining factors of social entrepreneurship in the urban context of Montijo and Afonsoeiro.

4. Results

This section presents the main findings, organized around the six pillars of the entrepreneurial ecosystem framework by Audretsch et al. (2022) and Isenberg (2011): Market, Human Capital, Culture, Institutional Support, Finance, and Public Policies. These dimensions offer a comprehensive view of the conditions shaping social entrepreneurship in Montijo and Afonsoeiro and highlight how different factors intersect and interact within this complex ecosystem.

4.1 Market

The analysis of the market dimension in Montijo and Afonsoeiro highlights a set of structural and social challenges that directly shape the conditions for social entrepreneurship. One of the most recurrent issues raised by participants is the profound shortage of local labour, which affects both the availability and quality of the workforce. This perception is captured in the remark: "We have a huge lack of workforce, not just of people, but of quality in people. And it's not a matter of paying more or less, they simply don't exist".

This shortage is further exacerbated by bureaucratic constraints associated with hiring foreign workers, as one participant emphasized: "All the bureaucracy to process the documentation is very complicated".

Participants also expressed dissatisfaction with the performance of public employment services, which are seen as ineffective in matching labour supply and demand. As noted by one interviewee: "I've tried several times to recruit through the Institute for Employment and Vocational Training (IEFP) and only people who don't want to work, who want subsidies, come up. I gave up". These limitations were reported as directly restricting the capacity of social initiatives to mobilize suitable human resources and respond to community needs.

Housing and transport issues also emerged as substantial barriers, impacting workforce stability and participation in social entrepreneurship projects. One participant observed: "This is a real problem", while another described: "There is no other form of transport because the Montijo station is outside the city. This is a problem that demonstrates the total lack of transport integration here". These challenges undermine access to employment and constrain the economic viability of community initiatives.

Moreover, social exclusion and discriminatory attitudes were reported as significant obstacles to labour market integration for marginalized groups. One participant remarked: "I've never had a gypsy come and ask me for work", revealing patterns of exclusion that continue to reinforce structural inequalities and limit opportunities for inclusive entrepreneurship.

Participants also referred to the existence of informal and exploitative labour practices, such as illegal clam harvesting, which were said to distort the functioning of the local economy: "There's a big problem with illegal clam harvesting. They're there in plain sight; it's a trafficking network". These dynamics create parallel economies that compete with formal social enterprises, undermining their viability.

Finally, skill mismatches between formal qualifications and actual labour needs were highlighted as a persistent challenge. One participant illustrated this by stating: "A girl who did hotel and restaurant service didn't even know how to carry a plate!". This gap indicates the need for tailored training aligned with local labour market requirements to support the emergence and growth of social entrepreneurship initiatives.

Overall, the market conditions in Montijo and Afonsoeiro are marked by structural labour shortages, weak institutional support mechanisms, and informal economic dynamics, all of which pose significant constraints to the development of a robust and inclusive entrepreneurial ecosystem.

4.2 Human Capital

The analysis of the human capital dimension reveals significant social and cultural vulnerabilities that shape the context for social entrepreneurship in Montijo and Afonsoeiro. One critical issue identified was the social isolation of elderly individuals, which is evident in the excerpt: “there are many elderly people in isolation”, suggesting the need for community-based initiatives to foster inclusion and support.

Another challenge relates to the fragmentation of local communities and the decline of associative life, illustrated by the participant's remark: “people are no longer willing to spend time with associations, and forgive me because you two are clearly younger than me, but people my age, I am 42 years old, are no longer willing to get off work and still go to the Neighborhood Association”. This points to a significant erosion of social participation and collective belonging.

The integration of immigrants and challenges related to family reunification emerged as a structural vulnerability within the territory. Participants reported that migration processes are often fragmented and prolonged, with families living apart for extended periods. As one participant remarked: “Most of the people who come here do not bring their children initially. They leave their children in their home country and come looking for better opportunities and to send money back”. These dynamics highlight the need for support mechanisms that facilitate integration and promote family stability.

Territorial exclusion and institutional discrimination emerged as critical barriers, exemplified by the comment: “I have already heard people say they refuse to speak another language, only Portuguese”. This underscores discriminatory practices that limit inclusion and necessitate interventions in cultural mediation.

The persistence of ethnic enclaves and limited interethnic interaction was also identified. One participant noted: “They enjoy themselves, they have parties among themselves, and they invite Portuguese people and little else”. While these networks can provide internal cohesion, they may also hinder broader societal integration. In parallel, language and relational barriers in public services were repeatedly mentioned: “People in public services are always in a bad mood and hate foreigners”. These perceptions point to the urgent need for culturally competent and inclusive public service provision.

Finally, participants observed the loss of community support and intergenerational solidarity, with a striking statement: “the sense of community has completely disappeared in some neighborhoods”. This highlights the urgent need for community-building initiatives that foster intergenerational solidarity, promote active citizenship, and restore trust in collective forms of participation.

In summary, the findings reveal a context marked by social isolation, weakened community ties, and limited migrant integration, all of which undermine the collective capacity to sustain inclusive social entrepreneurship. Strengthening this dimension requires proximity-based approaches and culturally sensitive interventions that rebuild trust and participation.

4.3 Culture

The analysis of the culture dimension underscores key elements that shape an entrepreneurial mindset within the social ecosystem of Montijo and Afonsoeiro. A prominent theme is the historical experience of Montijo as a welcoming territory, which provides a cultural foundation perceived as conducive to community-based initiatives. As one participant stated: “Montijo, in historical terms, has always been a welcoming land. In the 1940s, it received people from the Algarve to work in cork, as well as people from the Alentejo, also to work in cork, and people from the Beira region to work in agriculture”. This narrative of openness, however, is now facing tensions arising from more complex and diverse migratory flows. As noted: “Now, the challenge is different, but the culture that has historically existed is now resisting, mainly these new realities”. These accounts suggest a growing disconnect between cultural memory and current integration dynamics, with potential implications for the cohesion needed in inclusive social entrepreneurship.

Empowerment through grassroots initiatives and self-organization further characterizes the entrepreneurial culture in this context. One participant highlights the emergence of local initiatives: “Very concrete initiatives have already been taken. I think that the next time we meet it will be precisely to outline the statutes and sign the creation of a residents’ commission for the entire neighborhood”. Such examples illustrate how communities leverage collective action to respond to shared challenges, reinforcing the participatory ethos critical to social entrepreneurship.

Creativity and innovation also play a central role in this cultural landscape, serving as resources for strengthening social bonds and fostering new forms of collaboration. This is particularly evident in educational and artistic projects that cultivate cooperative skills and collective responsibility. One participant affirms: “Orchestras in schools, for example, are an excellent idea. Through an orchestra, you start working in community, with small groups within each section, and the final result depends on everyone working together”. Such initiatives highlight the transformative potential of cultural activities in building inclusive and resilient social structures.

Moreover, the role of education as a catalyst for fostering collaboration and bridging cultural divides is strongly emphasized. A participant notes: “I think that the school has a tremendous importance in changing some of the school curricula so that our young people become much more collaborative with each other”. This perspective situates education at the core of entrepreneurial culture, positioning it as a fundamental mechanism for empowering younger generations to engage proactively in social innovation and collective well-being.

Collectively, these narratives illustrate how historical hospitality, grassroots mobilization, creative expression, and educational engagement contribute to shaping a locally rooted entrepreneurial culture. This cultural dimension enhances the viability of social entrepreneurship initiatives by strengthening community agency, promoting inclusive participation, and supporting collaborative responses to complex social challenges.

4.4 Institutional Support

The exploration of institutional support within Montijo and Afonsoeiro reveals a landscape marked by intermittent technical assistance, bureaucratic complexity, and strong dependence on central structures. Discussions highlighted the centrality of the IEFP as the main institutional actor. One participant noted: “the IEFP is seen today as salvation, because there is nothing else”. This perception reflects a context of institutional scarcity, where few alternatives exist for those seeking support. However, this reliance also exposes local actors to the limitations of a system often perceived as rigid and distant.

Technical support entities also play a fundamental role in fostering initiatives, although constrained by structural and logistical challenges. One participant described the process of technical accreditation: “There is a process of accreditation with the IEFP, and then there is a territorial division decided centrally. After that decision, six months later, there may be a regional decision to include new territories for these technical support entities”. However, these technical supports face obstacles due to complex regulations, as admitted: “Regulations with 40 or 50 pages end up not being easy to be understood by everyone”. This reveals the tension between the need for robust governance and the accessibility of institutional support.

Another critical factor is the coordination with local governments and the involvement of municipalities in creating supportive environments. Nevertheless, challenges arise in synchronizing efforts, as reflected by the remark: “We have conditions to do it, but it is not always easy to reconcile everything: schedules, willingness, and whether there is transport or not in the place”. This statement indicates that while institutional structures are in place, logistical issues often hinder the full potential of support initiatives.

A further recurring theme was the ambivalence of institutional engagement, particularly in interactions with the IEFP. While the institution plays a regulatory and funding role, it is rarely perceived as a partner in the entrepreneurial process. One participant observed: “We do not have the accompaniment of the IEFP that is there to help: 'Do you have doubts? I will help you'. With us, it is different: 'Where did you spend this? Was this invoice real or not?'”. This comment illustrates a perception of institutional mistrust and excessive bureaucratic control, which discourages initiative and creates barriers to project development.

Overall, the findings reveal an institutional ecosystem marked by centralization, bureaucratic complexity, and weak local coordination. While structures like the IEFP offer formal support channels, their limited proximity and lack of proactive engagement reduce their effectiveness. Likewise, municipal and technical entities remain underutilized due to logistical and governance constraints. These dynamics hinder the formation of a cohesive support system, underscoring the need for more decentralized, accessible, and trust-based institutional frameworks.

4.5 Finance

The analysis of the financial dimension in Montijo and Afonsoeiro underscores the main instruments of financial support available for entrepreneurial initiatives. A central mechanism identified is the set of measures from the IEFP. As one participant explained: “For those who want to start something new, the IEFP’s supports are organized that way: either you use the unemployment subsidy to create a new business or acquire a share of an

existing one, or, being in a situation of unemployment, you can access lines of credit with subsidized interest rates". These pathways provide aspiring entrepreneurs with essential starting points to pursue economic activities in the territories.

In addition to direct financial incentives, the IEFP promotes programs that combine financial assistance with employability strategies. As described: "These measures are professional internships, where afterwards there is hiring… The internship is for those who have completed a degree, higher or middle school, and want to integrate into an employer". This reflects a multifaceted approach, linking financial support to broader socio-economic integration.

A critical concern raised by participants is the reduction in direct funding mechanisms specifically targeted at social entrepreneurship: "We had created direct social entrepreneurship, which no longer has measures". According to participants, this contraction of resources has disproportionately affected rural and marginalized territories, where entrepreneurial ecosystems are more fragile and dependent on external support. The loss of these funding lines was seen as a barrier to the emergence and continuity of inclusive, community-based initiatives.

Finally, participants called for greater responsiveness and commitment from the government to expand and adapt funding structures that address the realities of these territories and the needs of socially vulnerable populations and newly arrived migrant communities. As stated: "There should be an opening and financial availability on the part of the Government. I am speaking outside of the IEFP".

In summary, although financial mechanisms such as those provided by the IEFP offer important entry points for entrepreneurial activity, their scope and accessibility remain limited in the context of social entrepreneurship. The withdrawal of targeted funding and the lack of tailored financial instruments constrain the development of inclusive initiatives in vulnerable territories, underscoring the need for more responsive and territorially adjusted financing strategies.

4.6 Public Policies

The analysis of the public policies dimension in Montijo and Afonsoeiro reveals a landscape in which municipal leadership and collaborative governance are central to fostering social entrepreneurship. One participant highlighted the proactive role of the municipality and its partnerships: "There have been several projects, including those we have addressed and with which we have been partners, mainly with the municipality, but also with other local actors at the level of social entrepreneurship". This underscores the municipality's role as a catalyst in the creation of inclusive, community-based economic initiatives.

The scope of these policies extends beyond the urban center, addressing rural contexts as well. As one participant noted: "It already exists, a first approach has already been made. Work has been developed in this sense". This statement points to an incipient but deliberate effort to include peripheral and rural areas within the reach of social entrepreneurship policies, reflecting an emerging territorial integration perspective.

Infrastructure limitations also emerged as a significant concern, directly impacting the capacity of social initiatives to operate: One participant remarked: "We have the problem of not having space. But even so, we have several associations operating in spaces ceded by the municipality". This speaks to the role of public policy in enabling access to essential resources for community initiatives.

Participants further emphasized the importance of local networks and collaborative structures in enhancing social entrepreneurship efforts: "The social network is very important because it gives opinions within the scope of social equipment". These networks foster not only knowledge exchange but also the legitimacy and effectiveness of social innovation initiatives.

Capacity-building and professionalization of third-sector organizations were also highlighted, as noted: "The entities have these things organized and make them known to their members". This demonstrates how regulatory frameworks can simultaneously encourage accountability and enhance the impact of community-led projects.

Finally, the dual nature of these frameworks was acknowledged, reflecting both their administrative burden and their potential to strengthen organizations: "We can see this from two points of view. From the point of view that it complicates, it is true. But on the other hand, it empowers". This duality illustrates how policies can be both an obstacle and an enabler in the ecosystem of social entrepreneurship.

In summary, public policy in Montijo and Afonsoeiro is marked by municipal initiative, emerging territorial inclusion, and structural limitations. While policies contribute to enabling conditions for social entrepreneurship, they are constrained by infrastructural gaps, bureaucratic complexity, and uneven implementation capacity. Addressing these tensions requires better-aligned, community-informed frameworks that balance governance with grassroots adaptability.

5. Conclusion

This study started from the premise that social entrepreneurship can be an innovative and situated response to urban inequalities, if it is framed in an ecosystem that values territorial specificities and local dynamics. The qualitative analysis carried out in the parishes of Montijo and Afonsoeiro allowed us to confront this hypothesis with the concrete reality of an urban-peripheral territory, where structural vulnerabilities and latent capacities coexist.

The diagnosis revealed a territory marked by asymmetries, from the shortage of qualified labor to the fragility of community support networks, but also by potentialities that are often invisible, such as local self-organization, the role of schools as engines of cohesion and creativity anchored in collaborative cultural practices. It is in this balance between obstacles and possibilities that the real challenge of social entrepreneurship lies: not only to make projects emerge, but to build ecosystems that sustain them and make them grow.

Through the model proposed by Audretsch et al. (2022), inspired by the systemic design of Isenberg (2011), it was possible to map the main constraints of the local ecosystem. The investigation identified significant blockages, such as territorial exclusion, disarticulation between entities, scarcity of resources, but also signs of collective agency and historical openness to diversity.

From a theoretical point of view, the study reinforces the contributions of authors such as Kiss et al. (2022), Marshall and Jang (2020) and Scaffidi et al. (2025), by applying the concept of social entrepreneurship ecosystem in a non-metropolitan territory. In this way, the empirical field of research is expanded, still predominantly centered on large cities.

The data highlight the critical importance of collaborative networks, inter-institutional mediation and local capacity building for the sustainability of initiatives. This conclusion is in line with the most recent literature that values multi-scale approaches and shared governance models (Barki et al., 2020; Micelli et al., 2023).

The results reinforce that well-intentioned public policies are not enough, it is essential that they are designed with and from the territory. Local experience has shown that when there is room for trust and mutual listening, fairer and more sustainable solutions emerge. However, without continuous support networks, many initiatives remain fragile and ephemeral.

The study offers a useful reading grid for public decision-makers and civil society organizations, helping to identify roadblocks and potential levers for more integrated responses. For future research, longitudinal monitoring of initiatives and comparative analysis with other peripheral territories are recommended.

Ultimately, this work aimed not only to study the territory, but also to listen to the voices of its people. In those voices, we found not only the diagnosis of deficiencies, but also the seeds of transformation. Social entrepreneurship, understood as a situated, collaborative and critical practice, proves to be a promising path for a more cohesive, resilient and inclusive Montijo and Afonsoeiro.

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Ethics Declaration

This research did not require formal ethical clearance as it did not involve any vulnerable populations or sensitive topics. All participants provided informed consent prior to their participation in the study.

AI Declaration

No generative artificial intelligence (AI) was used in the writing or editing of this work.

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Mapping and Analysing the Scottish SME Landscape to Support Change Management Initiatives

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Abstract: Small and Medium-sized Enterprises (SMEs) are recognised as key drivers of economic growth. Despite their significant contributions, Scottish SMEs face many challenges and barriers when transitioning from a start-up to scale-up, including, for example, adapting to organisational structures, securing funding, and having limited time to develop innovation strategies. This study aims to understand the change management needs of Scottish SMEs in the scale-up phase and map the current business support landscape while exploring how these needs are perceived by support consultants. The paper begins by setting the context of the SME landscape across Scotland before describing how the data was gathered through semi-structured interviews with business support and change management consultants to determine the strategic barriers that SMEs face. The technique of empathy mapping was used to initially visualise and document SME needs, followed by a Thematic Analysis (TA) to uncover deeper research themes and insights. The findings reveal specific challenges related to mindset, leadership, and cultural factors that impact growth and change management for SMEs. The research also highlights the importance of business community engagement, the necessity of open-mindedness and receptiveness to external advice in enabling SME founders to grow and change. The paper concludes by discussing trends and gaps in the SME support landscape and emergent opportunities for intervention, laying the groundwork for a broader conversation on the systemic conditions shaping SME success in Scotland and underscoring the need for further research into how support for SMEs is designed and implemented in an ever-evolving landscape of small business growth.

Keywords: SMEs, Change Management, Growth Aims, Scaling-up, Mindset, Leadership and Culture.

1. Introduction

In the UK, Small and Medium-sized Enterprises (SMEs) represent a significant percentage of the economy, and "accounted for 99.9% of the UK business population at the start of 2024, with 99.2% being small businesses with fewer than 50 employees" (Department for Business & Trade 2024). According to the Procurement Act 2023, an SME is generally characterised by its number of employees (fewer than 250), annual turnover (less than or equal to £44m), and total assets (Government Commercial Function 2024). SMEs are vital to the UK's economic success, contributing to innovation, the creation of long-term employment opportunities, and the increase in added value to the local economy (Varga 2021). Despite their significant contributions, SMEs face many challenges and barriers when transitioning from a start-up to scale-up, including, for example, adapting to organisational structures, securing funding, and having limited time to develop innovation strategies. Change is hard. Kotter (2011) usefully points out that many businesses often make mistakes and are likely to fail during change initiatives, largely due to many managers overlooking the fact that transformation is a gradual, ongoing process (p.3). Therefore, SMEs would benefit from tailored change management processes and strategies to achieve continued growth and renewal. Moran and Brightman (2001) define change management as "the process of continually renewing an organization's direction, structure, and capabilities to serve the ever-changing needs of external and internal customers" (p. 111). While many step-by-step change management models and offerings exist (e.g. McKinsey's 7-S Model, Lewins 3-Stage Model of Change and Kotters's 8-Step Change Model) that aim to plan, implement and sustain organisational change, they mostly serve larger organisations leaving a gap in the business support market that would cater to the distinct needs of SMEs. Indeed, only a few studies have explored innovation-related people and change management practices within an SME context. This is partly because Human Resources practices in SMEs are still emerging with limited focus on people management (Reid et al. 2002) at the early stages of the scale up process.

This study is part of a wider two-year Knowledge Transfer Partnership (KTP) research project funded by Innovate UK, which aims to develop, test and implement a design-led change management service to help Scottish SMEs grow. The focus of this paper centres on the change management needs of Scottish SMEs in the scale-up phase and investigates the current business support landscape while exploring how these needs are perceived by support consultants. The paper begins by setting the context of the SME landscape across Scotland, paying

particular attention to the change management literature. It then goes onto describe how data was gathered through semi-structured interviews with 14 business support and change management consultants to determine the strategic barriers that SMEs face, underscoring the pressing need for further research into how support for SMEs is designed and implemented in an ever-evolving landscape of small business growth.

2. The Scottish SME Landscape

SMEs play a crucial role in Scotland's economic success with an estimated 355,805 SMEs delivering 56.9% of all jobs in the private sector and generating an annual turnover of 41.7% (Scottish Government 2024a). The latest figures by the Scottish Government (2024a) provide an up-to-date picture of the SME landscape in Scotland, indicating the following:

- Approximately 174,085 (49%) of all private sector SMEs operate above the VAT threshold, which represents a first-time increase of 0.4% since 2020. The number of unregistered businesses has more than doubled (from +94,915) since 2000 while VAT registered businesses have only increased by 17.1% during that time.
- Registered and unregistered SMEs are therefore currently responsible for providing an estimated 1.2 million jobs within the Scottish economy, which is more than half of all of Scotland's private sector employment.
- Within the SME category, small versus medium-sized businesses are unevenly distributed, with 98.2% of private sector businesses operating as small enterprises (0 to 49 employees) while 1.1% operating as medium-sized businesses (50 to 249 employees). This high percentage of small businesses in comparison to medium-sized businesses suggests that there is a high potential of businesses that need upscaling support for their future operations (Figure 1).
- The Professional, Scientific and Technical Activities, Construction and Wholesale/Retail sectors are the three largest private business sectors in Scotland accounting for 34.5%.
- Data from local authorities shows an imbalanced spread of the number SMEs across Scotland. Rural areas demonstrate a higher occurrence of SMEs (Orkney 82%) compared to the Central Belt (Glasgow City 38%).

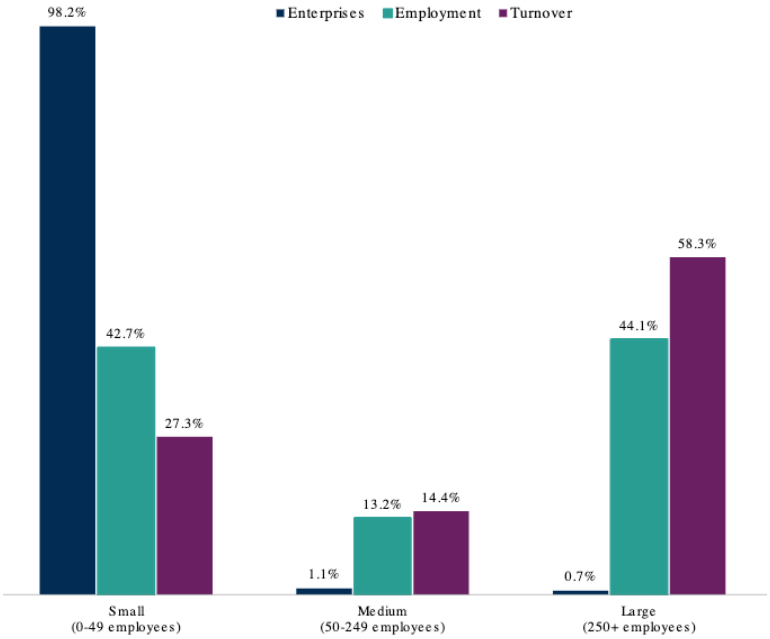


Figure 1: Private sector businesses operating in Scotland (as at March 2024)

Source: Scottish Government (2024a)

While Scotland has displayed significant growth potential since the Covid-19 pandemic, challenges and obstacles to growth remain such as the level of energy prices, taxation and the UK's exit from the European Union (Department for Business & Trade 2024). Nonetheless, there are strengths and opportunities for growth in the Scottish economy. Figure 2 provides a snapshot of these strengths, highlighting that overseas visits to Scotland

have recovered faster compared to the rest of the UK since the pandemic, productivity has continued to grow since 2007, and 58% of businesses are exporting internationally with a GVA increase of 108% between 2012 and 2022.

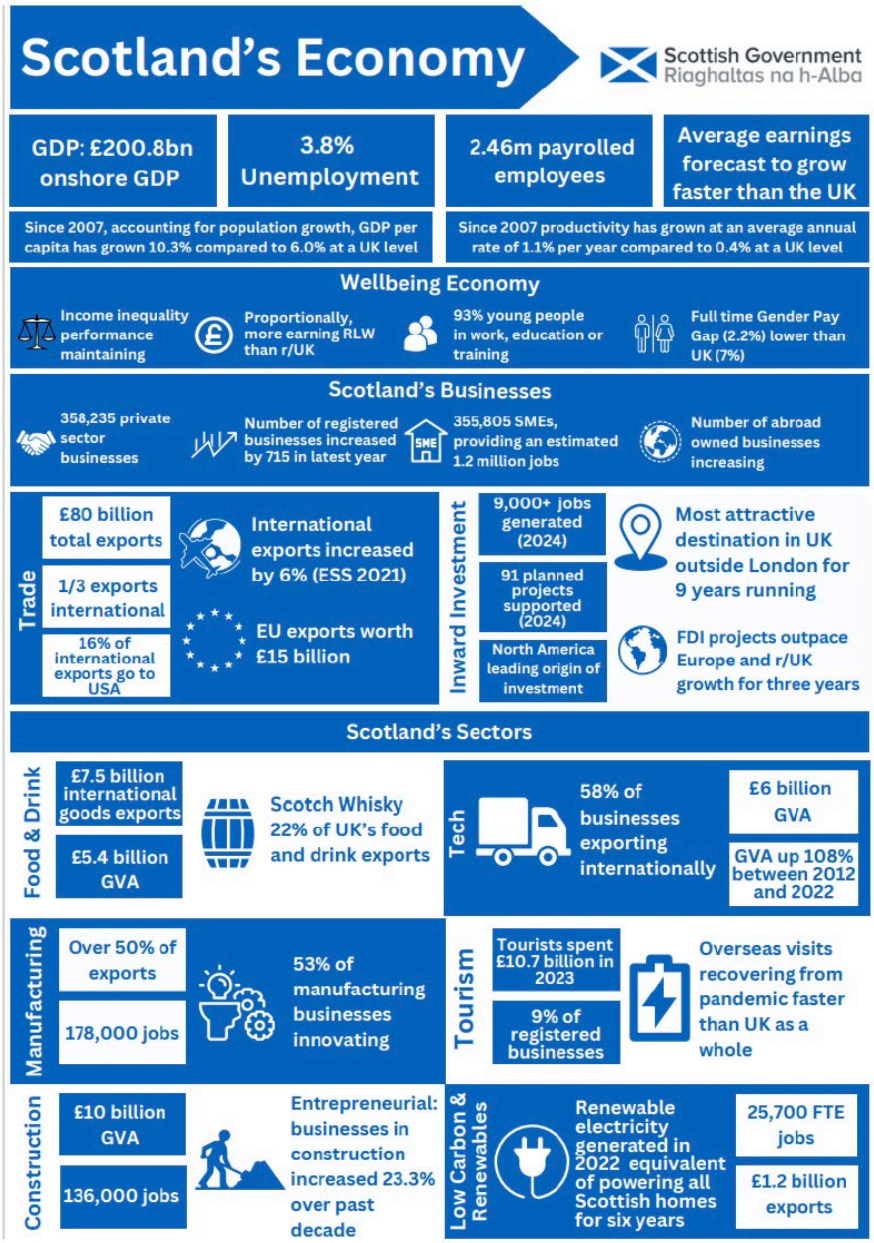


Figure 2: provides a snapshot of the strengths and opportunities of Scotland's economy,

Source: Scottish Government (2025)

Currently, 50% of SMEs operating in Scotland do not employ any staff beyond the entrepreneur. Dingwall and Cook (2023) point out that "more than three fifths of Scottish SMEs plan to grow their business in the next two years" with growth plans "highest in the Information and Communication sector (84%) and lowest in the Transportation and Storage (36%), and Accommodation and Food Service Activities (37%) sectors" (p. 47). This finding is also supported by data from the Small Business Survey Scotland: 2023-2024 which indicates that accessing business support networks related to growth is top priority (23%), closely followed by finance (22%), tax and insurance (18%) advice (Figure 3). Therefore, facilitating growth and scaling up these businesses is considerably important for the Scottish economy, as it offers significant potential for growth.

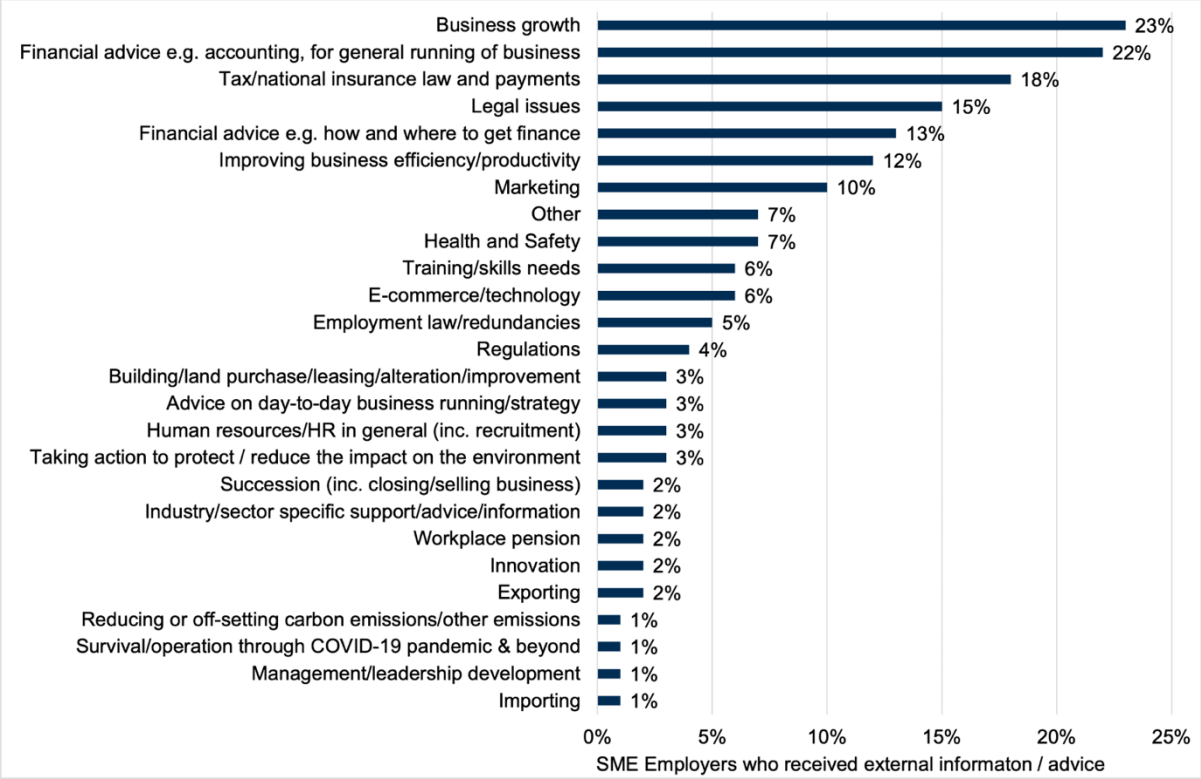


Figure 3: Reasons for Using Information or Advice (2023-24). Multiple answers allowed across this question. Source: Small Business Survey Scotland 2023-2024 (Scottish Government 2024b).

To support SMEs on their growth journey, a robust support network is required. Hrusková, Mason, and Herzog (2023) observe that the Scottish entrepreneurship support landscape consists of many entrepreneurship support organisations (ESOs) offering a broad range of services but often failing to differentiate between support for start-ups and scale-ups or to clearly target specific segments of entrepreneurs. This lack of differentiation makes it challenging for entrepreneurs to identify the most suitable service for them, contributing to the perception of a "cluttered landscape" with too many players. The authors further note that entrepreneurs typically engage with multiple support providers throughout their entrepreneurial journey. The support of business growth in Scotland is delivered through either government and public sector funded business accelerator programmes, such as Help to Grow (University of Dundee 2025) or private sector growth support from consultants, investors, coaches and industry experts. Business support for growth is often to prepare businesses for an organisational change. This is not a coincidence, as SME's generally find it difficult to plan and implement a change strategy due to limited resources and conflicting operational priorities. As described by Kotter (1996) "Change management refers to the methods and manners in which a company describes and implements change within both its internal and external processes" (p. x). Moreover, "(…) the central issue is never strategy, structure, culture or systems. (…) The core of the matter is always about changing the behaviour of people (…)" (Kotter and Cohen 2002, p. xii).

3. Change Management Challenges for SME's

SMEs encounter multifaceted pressures that call for agile responses. Market dynamics, including evolving consumer preferences and intensifying competition, require SMEs to position themselves strategically (Burns 2016). This context highlights the need for ongoing innovation, as SMEs strive to sustain competitive advantage through activities such as strategic optimisation, diversification, and product development. Okręglicka, Gorzeń-Mitka and Ogrean (2015) emphasise how SMEs navigate the challenges posed by rapidly changing market conditions, arguing that embracing complexity can enable them to transform external threats into opportunities and internal weaknesses into strengths, despite the inherent difficulties of such approaches. While the concept of change management is often associated with larger organisations, it is equally pertinent for SMEs (Wiesner, Chadee and Best 2017). Given their typically smaller size and greater proximity to customers, SMEs possess the advantage of agility and flexibility, enabling them to respond more swiftly to market changes and customer needs compared to larger enterprises (Nastase, Lisetchi, Bibu, 2014). This adaptability helps the development

of innovative strategies and supports the ongoing evolution of the business. The role of the entrepreneur or owner-manager is widely recognised as central to determining the functionality and performance of SMEs, based on their vision and decision-making. The actions, decisions, and characteristics of the entrepreneur have a significant influence on the success and sustainability of the business, both in the short and long term, as well as in relation to growth and adaptability (Nastase, Lisetchi, Bibu, 2014). Furthermore, modern companies increasingly seek to balance profit with social impact, reflecting broader shifts in business priorities. Recent research by Albarracin, Fayaz-Farkhad and Granados Samayoa (2024) highlights the importance of targeting effective drivers of behavioural change within organisations. Their work identifies those interventions addressing both cognitive and behavioural factors, such as knowledge, skills, attitudes, and social support, that are particularly promising. Strategies that incorporate emotional and behavioural skills, alongside traditional approaches, tend to yield more sustainable effects, especially when interventions target both the legal-administrative and social dimensions of organisational behaviour. As such, fostering adaptability and learning within SMEs is crucial for converting potential threats into opportunities and supporting sustainable growth in an increasingly complex global environment. That said, SMEs typically lack the "(…) internal capabilities for proactive change" (Ates and Bititci 2011, p. 5602), time (Kindström, Carlborg and Nord 2022), financial and human capital (Van Gils 2005) to successfully implement change initiatives. According to Kindström, Carlborg and Nord (2022) they "tend to emphasize tactical and operational aspects thus neglecting more long-term strategic activities" (p. 713). Against this backdrop it seems pertinent to investigate the change management needs of Scottish SMEs in the scale-up phase and map the current business support landscape while exploring how these needs are perceived by support consultants.

4. Data Collection and Analysis

In collaboration with the University of Dundee and a consultancy based in Scotland, this KTP research project aims to understand the change management needs of Scottish SMEs in their scale-up phase in order to develop a design-led change management service. As part of the wider project, this particular study provides findings on the current business support landscape for SME's while exploring how these needs are perceived by business support and change management consultants. Hall's (2022) Sampling Strategy Framework for design research was used to inform the study design, the formulation of interview questions, and the participant recruitment process (Figure 4). By 'design research' Hall implies "(…) asking and answering questions in a systematic way in order to make more intentional and informed decisions about planning and creating new things and ways of doing things". The rationale for adopting Hall's framework to map the SME support landscape in Scotland lies in its flexible approach, efficient time and resource allocation to achieve desired outcomes, and capacity to offer rich insights into real world contexts. The data was gathered through semi-structured interviews with 14 business support providers and change management consultants over a period of 2 months to determine the strategic barriers that SMEs face. A semi-structured interview approach was chosen due to its flexibility in exploring participants' insights while maintaining a focus on the key research objectives (Ellis 2016). More specifically, the interviews were designed to uncover information about the current change management needs of SMEs in Scotland as well as the nature of the obstacles relating to the implementation of change. The interviews were recorded and transcribed, and the technique of empathy mapping (Gray 2017) was used to initially visualise and document SME needs (to be reported in a subsequent paper). Thematic Analysis (TA) was then used to allow recurring themes and insights to emerge organically through inductive coding grounded in the empirical data (Clarke & Braun 2017). This produced initial codes that were collapsed or collated to form an over-arching theme 'Growth Transformation' and the process ultimately informed the development of four sub themes that reflect core patterns within the dataset, namely (1) Place-based Obstacles & Opportunities; (2) Mindset; (3) Growth Aims; and (4) Cultivating Culture and Leadership.

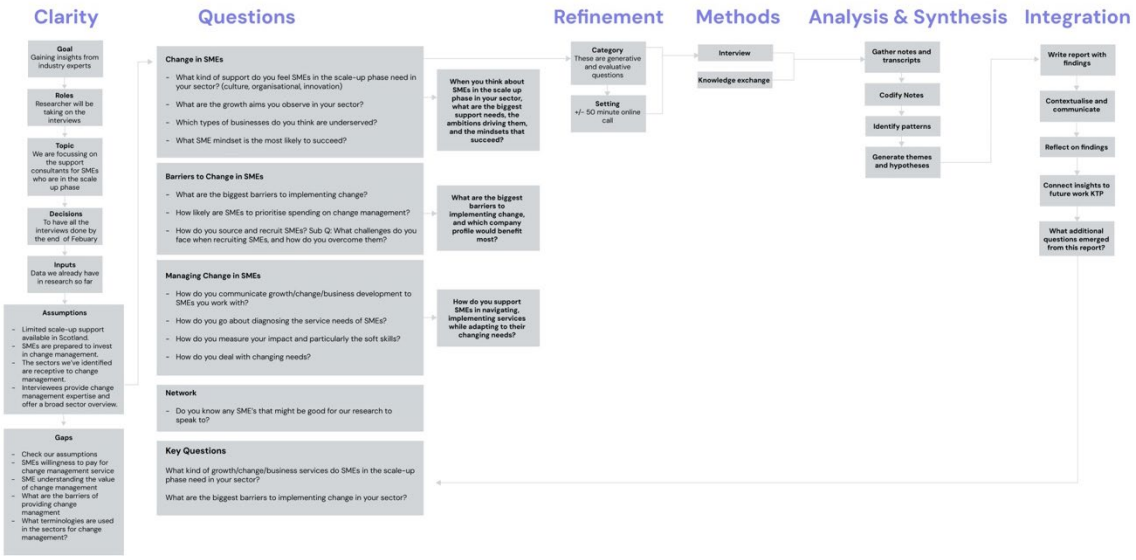


Figure 4: Sampling Strategy Framework (Hall 2022)

5. Findings

Access to finance is widely regarded as the primary obstacle to growth for SMEs, as noted by the business support providers interviewed in this study. However, it is important to note that this research focuses on the people-related aspects of change management rather than financial constraints. As such, the following findings reveal several key challenges related to growth and change management. The TA produced initial codes that were collapsed or collated to form an over-arching theme, namely 'Growth Transformation'. This overarching theme was underpinned by four sub themes, namely: (1) Place-based Obstacles & Opportunities; (2) Mindset; (3) Growth Aims; and (4) Cultivating Culture and Leadership.

5.1 Place-based Obstacles and Opportunities

According to the Scottish Government Urban Rural Classification 2020 (2021), 66% of SME employers in Scotland were located in urban areas, while 34% operated rurally. In many of the interviews, business support providers operating in rural areas highlighted both the advantages and challenges presented by the region's geography.

Micro SMEs (0-9 employees) account for almost half (45%) of employment in remote rural areas and over a third (35%) (Scottish Government 2022) in urban areas. According to the interviewees, many SME founders choose to establish their businesses in these areas due to a strong personal attachment to the land and the region rather than locate their business operations in more profitable regions or markets. This enables business owners to sustain a desired lifestyle while knowingly giving up opportunities of maximum business growth. As one interviewee observed, many SMEs in the Highlands and Islands are vocation-driven, with business owners pursuing a broader mission beyond financial gain. A strong motivation among these businesses to employ local residents positively contributes to the regional job market. However, the desire to hire locally is in contrast with the frequently cited skills shortages, not only in rural areas but also across the whole of Scotland, particularly in practical, industry-specific roles. These shortages often limit SMEs' ability to take on larger contracts due to a lack of available workforce. For example, in the food and drink sector, some businesses struggle to expand into markets beyond Scotland, including England and Wales due to staffing constraints. Despite these challenges, the geographical landscape also presents opportunities for emerging industries, such as the space sector and the transition to green energy in the sea. However, as one interviewee pointed out, the infrastructure necessary to attract highly skilled professionals to rural areas is a challenge. A lack of luxury housing refrains professionals from relocating to these regions. Another obstacle that sits in the way of growth specifically for Micro-SMEs in rural areas is community dynamics. In some cases, interpersonal conflicts or local rivalries may impede business success. Nevertheless, initiatives by organisations such as Highlands and Islands Enterprise (HIE 2025) are actively working to mitigate these challenges, foster collaboration, and support business development in these areas.

5.2 Mindset

A recurring theme in the interviews was the concept of mindset. In particular, the Scottish mindset was frequently described as one of extreme humility. This cultural characteristic manifests in various ways, notably in the reluctance of Scottish SME owners to seek external investment or engage in debt financing. This hesitancy is, in part, linked to difficulties in self-promotion, as many SMEs struggle to present themselves in front of investors or their target market. A prevailing attitude of "don't mind me, I'm just doing my thing in this corner" often results in businesses not receiving the visibility they require to grow. Several interviewees suggested that Scotland could potentially adopt certain aspects of entrepreneurial mindsets seen in regions such as Silicon Valley. However, there was some scepticism regarding how well this approach would align with Scottish cultural values. Beyond the specifically Scottish context, mindset was widely identified by interviewees as a critical determinant of both SME success and the implementation of business support initiatives. A key argument presented was that SMEs with the right mindset are more likely to achieve growth. Consequently, business accelerator programmes often assess the mindset of potential participants in advance. Interviewees noted that individuals with a closed mindset characterised by resistance to learning and an unwillingness to accept guidance, tend to hinder both their own success and that of other participants in the programme. One interviewee likened the process of assessing a company's mindset to a doctor's consultation, suggesting that by engaging in conversations with SME owners, their mindset and the likelihood of successful intervention can be determined.

5.3 Growth Aims

The interviews with business support providers revealed a nuanced picture of growth aims among Scottish SMEs that challenged traditional economic metrics. Many Scottish SMEs have different growth aims compared to well-established businesses. Interviewees suggested SMEs tend to prioritise objectives beyond revenue expansion, market share, and employee numbers with their ambitions focused more towards, maintaining relevance, remaining manageable as well as sustainability and quality of life. As one interviewee observed, growth might not even be the right term, as most SMEs seem less motivated by profit maximisation, but instead focus on building relationships while keeping a steady flow of workstreams. In rural areas of Scotland another interviewee pointed out that businesses often align their development goals with their vocational calling, aligned with the Sustainable Development Goals (SDG) (United Nations, 2024), creating local employment opportunities or maintaining locally sourced production methods. Interestingly, a tension between authentic growth intentions and funding requirements was revealed. To secure public funding, SMEs often claim to have high growth aspirations, though these claims are not always realistic or genuine. Some SMEs reported feeling pressure to use business growth terminology simply to secure funding. One interviewee specialising in the technology sector noted that whilst many founders express ambitions to grow, they frequently lack concrete plans or practical steps to achieve these ambitions. Similarly, SMEs in the wellness and social care sectors often prioritise social impact, sometimes undermining their business sustainability. Interviewees generally agreed that many Scottish scale-ups lack clear vision, and few SMEs have undertaken appropriate market research to understand the key points in their growth journey where value significantly increases. While the study suggests that most Scottish SMEs do not necessarily aspire to grow in conventional ways, notable exceptions exist in sector-specific contexts. For instance, businesses operating in technology, space, life sciences, and energy services tend to align more with traditional growth indicators, such as team expansion, profit generation, and exit strategies. Sectors such as food and drink, manufacturing, and micro-enterprises often focus on production-oriented growth, particularly in terms of scaling operations to access cross-border or EU markets.

5.4 Cultivating Culture and Leadership

When discussing barriers to SMEs growth and scaling, numerous interviewees emphasised that a healthy working culture is essential. A "good" working culture is one that serves a critical function in staff acquisition and retention, particularly as SMEs are often unable to match the competitive salary packages offered by larger organisations. Instead, they must foster a workplace environment that both retains current employees and attracts new talent. Several challenges emerge in this context. For instance, founders frequently struggle to articulate organisational values to new staff members, with one interviewee noting a tendency amongst entrepreneurs to seek replicas of themselves during recruitment rather than acknowledging the value of diverse skill sets. Moreover, many founders lack formal management training, which hinders workplace innovation whilst simultaneously managing operational demands. The immediate pressures of daily operations typically take precedence over long-term cultural development initiatives, despite their importance. From a leadership

perspective, mature and family businesses tend to adopt autocratic approaches, whereas new established SMEs demonstrate greater adaptability to change. One interviewee indicated that many SMEs suffer from "accidental managers" meaning capable operators who have been promoted to leadership positions without adequate management training. The interviewee went on to suggest that a leadership approach significantly shapes organisational culture effectively removing obstacles whilst maintaining appropriate distance from day-to-day operations. In contrast, inadequate leadership fosters political manoeuvring and interpersonal conflict that ultimately undermines project success. It is also important to note, as several interviewees emphasised, that simply establishing a management strategy is not enough, and instead distributing decision-making authority and responsibility is crucial for business success. Interestingly, it was highlighted that many SME founders are reluctant to delegate authoritative control, which has significant implications. For instance, when founders overvalue their own technical expertise, they often disproportionately allocate resources towards technical proposition development, consequently undervaluing contributions from other team members. Other interviewees noted the importance of formalised staff engagement and open-door policies, advocating for workplace cultures that prioritise knowledge sharing and staff empowerment over traditional top-down management approaches. They suggested that decision-making responsibilities should be distributed across various organisational levels rather than concentrated at the top. It was mentioned that family run businesses struggle most with implementing a new working culture.

6. Discussion and Conclusion

The findings reveal how Scotland's urban-rural divide shapes business support needs. Understanding rural challenges is important when designing support, addressing infrastructure gaps, leveraging community dynamics, and mitigating regional workforce limitations. By recognising these place-based factors, it allows support organisations to develop more targeted interventions. The geographical remoteness presents particular challenges for talent acquisition, as SMEs struggle to develop compelling value propositions. However, this apparent disadvantage may be reframed as a potential competitive advantage. For instance, the findings suggest that the Highlands and Islands of Scotland offer distinctive lifestyle benefits that align with vocational desires for work-life balance and connection to nature. Rather than viewing geographical isolation as a barrier, bespoke support could help SMEs leverage these unique regional characteristics to attract the talent which seek alternative lifestyle arrangements that urban environments cannot provide.

It was noted that there is considerable scope for evaluating SME potential beyond sector-specific frameworks. Indeed, mindset emerges as a critical variable in assessing SME growth prospects and designing targeted business support interventions. The cultural tendency toward humility in Scottish SMEs directly impacts bold investment decisions and drive for growth. Therefore, interventions must encourage a change in mindset to counteract cultural habits. The cultivation of mindset characteristics not only facilitates SME growth trajectories but proves equally essential for successful support outcomes. By recognising that a healthy balanced humility, self-awareness, and resilience can stimulate success, resources can be allocated to nurture these traits. The idea of a ‘defining the right mindset’ varies among individuals, but based on the interview data, a consensus consisted of four key components:

1. A healthy degree of humility: While excessive humility can be detrimental, a balanced level is beneficial, as inflated egos can obstruct growth.
2. Self-awareness and open-mindedness: Successful SME leaders recognise their own and their company’s strengths and weaknesses. They are also receptive to innovation and external advice rather than resisting change.
3. Resilience and passion: Running a SME is inherently challenging, with crises being an inevitable part of the business landscape. The ability to navigate difficult periods is crucial for long-term survival and success.
4. Leadership skills: Good leadership within an SME is often a key factor in determining its overall success.

The findings show a disconnect between the traditional growth metrics used by policymakers and the actual aspirations of many Scottish SMEs. This misalignment often leads to what can be described as ‘goal distortion’, where businesses feel compelled to reshape their true ambitions to meet funding requirements. As a result, both business planning and support programme effectiveness may be compromised. Many Scottish SMEs define growth in broader terms than financial expansion alone, prioritising goals such as work-life balance, community impact, and personal fulfilment. These more holistic aspirations challenge the current “high growth narrative” of business support services. Therefore, it is essential that business support services understand growth

aspirations and design more tailored support offering in alignment with what Scottish businesses genuinely value, rather than imposing standardised packages.

It is also clear from the findings that failure in leadership can hinder change. Founders, especially in small or family-led businesses often struggle with delegating and adapting to managerial roles. This reluctance, combined with skills gaps and limited resources, frequently blocks growth and change initiatives. Continuous support structures and training that offer leadership advice for SMEs is integral for the ever-evolving business community. Leadership skills are also pivotal in the creation of productive work environments. Therefore, a positive and intentional organisational culture, one that encourages innovation, openness and personal development is vital for SME success but is often undervalued and difficult to implement. This needs to be carefully considered by support providers as they tailor their offerings.

In conclusion, this paper sought to understand the change management needs of Scottish SMEs in the scale-up phase and map the current business support landscape while exploring how these needs are perceived by support consultants. The interviews highlighted place-based obstacles and opportunities, mindset, growth aims and cultivating culture and leadership as the most significant topics to support Scottish SMEs. These findings will now be used to inform the remaining workstreams of the wider KTP project to support the development of a design-led change management service to help Scottish SMEs grow. The research continues.

Ethics Declaration

Ethical approval for this study was granted by the School Research Ethics Committee (SREC) at the University of Dundee.

AI Declaration

No AI tools were used for either the data analysis or writing of the paper.

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Entrepreneurial Learning and Entrepreneurship Education in Business: The Case of the Aegean Archipelago

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Abstract: Entrepreneurial learning and entrepreneurship education are two distinct concepts which, even though they are often considered identical, are clearly differentiated in academic literature. While a significant number of studies have explored the ways in which entrepreneurship is taught within formal education systems, such as university programs and structured training initiatives, there are also studies emphasizing experiential forms of entrepreneurial learning. These include learning through observation, accumulated experience, and informal knowledge-sharing mechanisms, which are fundamentally different from structured educational approaches. This research aimed to map the landscape of entrepreneurial knowledge and education among businesses and entrepreneurs in the Aegean Archipelago, addressing a notable gap in the documentation of entrepreneurial activity in this geographically specific context. Drawing on data collected from 512 businesses/entrepreneurs, the research provides valuable insights into how entrepreneurial learning and entrepreneurship education are perceived, acquired, and applied. The findings shed light on both the formal and informal mechanisms through which entrepreneurs develop their skills, offering a comprehensive understanding of entrepreneurship in peripheral and regional environments.

Keywords: Entrepreneurial Learning, Entrepreneurship Education, Entrepreneurial Knowledge, Entrepreneurial Education, Aegean Archipelago

1. Introduction

Entrepreneurial learning and entrepreneurship education are distinct concepts that, despite often being seen as identical, are clearly differentiated in the literature. As a starting point, clarifying the terminology is essential to ensure a shared understanding of the key concepts.

Starting with entrepreneurship education (henceforth, EE) is the formal way of learning entrepreneurship. Previous research suggests that one factor in increasing entrepreneurial behavior, both for those already engaged in entrepreneurship and future entrepreneurs, is entrepreneurial education (Liñán et al., 2010). In particular, EE refers to the scope of curricular, lectures or courses that provides students with entrepreneurial competencies, skills and knowledge in pursuing entrepreneurial career (Fayolle, Gailly, and Lassas-Clerc, 2006; Ekpoh and Edet, 2011; Ooi, Selvarajah and Meyer, 2011). EE is an established academic discipline (Nabi et al, 2017; Bae et al, 2014), and the increase in EE programs in the last twenty years (Global Consortium of Entrepreneurship Centers, 2009; Safranski, 2004) shows that aspects of entrepreneurship can now be taught (Gendron, 2004; Kuratko, 2003, Kuratko, 2005, Lee et al., 2005). Regarding the content of such programs, through a comprehensive review of EE, Solomon et al. (2002), concluded the ideal elements of an entrepreneurship program such as negotiation, leadership, creative thinking, innovation, career choices, entrepreneurial personality, sources of venture capital, risk taking and tolerance for ambiguity, as well as the needs and constraints of an entrepreneurial venture during its life cycle (Katsimpiri, V. and Kinias, I., 2021, Kinias, I.G., 2009). Through the training programs, these topics are expected to benefit the trainees by fostering their entrepreneurial spirit and personality to manage daily difficulties and challenges of business life.

On the other hand, is the concept of entrepreneurial learning (henceforth, EL) which refers to informal sources of entrepreneurial knowledge (non-formal way of learning). Complementary to the formal ways of learning, in the literature there is a smaller amount of researches that have to do with the non-formal ways of EL, the more experiential ones, as they are characterized. Over the last decade approximately, EL has increased its citation in the research field. The topic has received different definitions from scholars in the past years. Often defined as “learning in the entrepreneurial process” (Holcomb et al., 2009, Politis, 2005), emphasizing how and when learning takes place (Wang and Chugh, 2014). Consequently, EL is described as “learning that occurs during the new venture creation process” (Pittaway and Cope, 2007). Also, Rae and Carswell (2001) defined EL as the dynamic process which enables entrepreneurial behavior to be enacted.

In line with the above, we define EL as what an individual does on an individual and/or organizational level to develop entrepreneurial skills. Research carried out so far identifies learning at the individual and group level and their individual dimensions without, however, placing them in a common and simultaneous framework. Furthermore, a deeper exploration of the literature reveals that these collective and individual ways of learning

are investigated by scholars. At the individual level, experiential learning constitutes a significant component of entrepreneurial development (Morrison and Brantner, 1992). It is understood as the process through which individuals transform their experiences into knowledge, drawing on their cognitive frameworks to interpret and internalize what they encounter (Kolb, 1984). Experiences become personally meaningful, thereby shaping the entrepreneur's learning journey and influencing future decision-making and behavior (Kolb et al., 2001).

According to studies, entrepreneurs learn from the day-to-day operations of the business, "learning by doing", as the term is prevalent, and it helps them to imprint their ventures more effectively from the beginning of their entrepreneurial activity by selecting better opportunities during their entrepreneurial journey (Huber, 1991; Ingram & Baum, 1997; Baum & Ingram, 1998). In addition, the more experienced entrepreneurs are, the more easily they develop daily business routines that they reuse in their business operations (Hayes, 1989). Moreover, research on EL indicates that a significant portion of learning within entrepreneurial contexts is experiential in nature (Politis, 2005, Rae and Carswell, 2001, Cope, 2003). This type of learning is widely understood as being situated within specific business environments and circumstances. It is often conceptualized as a cyclical process (Corbett, 2005), where knowledge is continuously developed through experience, reflection, and adaptation to the challenges and dynamics of the entrepreneurial context (Cope, 2003, Rae, 2005).

Another form of EL that has been mentioned about twenty years ago (Shepherd, 2003) is that of learning from failure and negative results of previous manipulations. Since then, several studies have been conducted to prove learning from failure (Ucbasaran et al., 2013, Wang and Chugh, 2014).

Extending the analysis to collective contexts, a key source of entrepreneurial learning can be found through the observation of role models, such as parents (Chalis and Kinias, 2019), friends, colleagues or other entrepreneurs, both before and during the start of the entrepreneurial activity (Zozimo et al., 2017).

While learning from networks is an area under investigation, there is an analysis of learning through participation in networks by which entrepreneurs assimilate learning (Rae, 2005). Also, the impact of social cues on entrepreneurial learning is also identified in earlier research (Taylor and Thorpe, 2004). Taking an even deeper review of the literature, networks seem to be a potential source of learning (e.g. Levitt and March, 1988, Powell et al., 1996, Uzzi, 1997) mentioning more specifically business-to-business networks (Hamel, 1991).

Finally, another way of providing business knowledge may be through a mentor. Studies have shown that mentoring by someone can be done on many levels, such as providing knowledge for career development, increasing salary, understanding business action (Allen et al., 2004, Wanberg et al., 2006).

2. Identification of Research Gap

Stepping into this study, the aim of this paper is to identify and present these concepts through an empirical study highlighting results and differences in EE and EL. We investigate EE as the entrepreneurial educational background of entrepreneurs, their knowledge of basic business concepts, their attendance of educational programs and the enhancement of entrepreneurial characteristics through them. In terms of EL, always based on the relevant theory, we examine how entrepreneurs have learned apart from EE.

In reviewing the literature, no similar research has been done in the past on the simultaneous projection on the landscape of EE and EL in enterprises. Thus, this study aims to address this gap by presenting findings derived from research focused on a specific part of the national economy, a defined geographical area of Greece, the Aegean Archipelago (Aegean Sea).

The Aegean islands are administratively part of three regions: North Aegean, South Aegean, and Crete. In the North Aegean, business representation is handled by three Chambers of Commerce: Lesvos (Lesvos, Lemnos, Agios Efstratios), Chios (Chios, Psara, Oinousses), and Samos (Samos, Ikaria, Fourni). In the South Aegean, there are two Chambers: the Cyclades Chamber (covering 24 islands) and the Dodecanese Chamber (covering 12 islands). This research focuses exclusively on the islands that make up the North and South Aegean regions, excluding islands attached to mainland regions and the island of Crete. These selected regions represent the majority of the Aegean island complex and form the geographical scope of the study.

The choice of location for the study is not random. However, apart from this research gap on EE and EL, this region also attracts attention for other research reasons, since this region is part of the economic whole of the country that has been suffering in recent years. Particularly, after the economic crisis, immigration has come to plague business in these areas even more. Government policies have highlighted the need to stimulate and strengthen entrepreneurship in these areas. Through targeted government programs in the tourism sector such

as grants for tourist facilities, subsidies to transport companies, and discounts for specific population groups, the state seeks to stimulate entrepreneurial activity and promote regional economic development.

However, questions arise such as how the entrepreneurial world uses its learning and education to stay alive in everyday entrepreneurship, to what extent businesses are trained in concepts essential for their survival, and how they intend to respond to emerging needs and challenges, and through which ways entrepreneurs learn away from the big urban centers and capitals. It is through these considerations that the research interest is shaped, giving rise to the core research questions that this study seeks to address.

According to all the above and the corresponding literature, the research questions were formulated:

RQ1. How entrepreneurship education is reflected in businesses/entrepreneurs in regionally decentralized economic areas?

RQ2. How entrepreneurial learning is reflected in businesses/entrepreneurs in regionally decentralized economic areas?

3. Methodology

In order to answer the research questions, empirical research was carried out in the island region of the Aegean Archipelago. The data considered crucial for the identification of EL and EE were drawn from the enterprises of the area.

3.1 Data Collection - Selection and Exclusion Criteria

The main data source for this research was the Aegean Chambers of Commerce, with five selected: Chios, Lesvos, Samos, Dodecanese, and Cyclades. To ensure a reliable and formal data collection process, initial contact was made with regional Chambers of Commerce, which provided key business information. In line with privacy regulations, only publicly available data (e.g., online email addresses) were used. An anonymous postal self-assessment questionnaire was sent exclusively to business owners. Data collection took place over a year (January 2024–January 2025).

3.2 Research Design

To address the research questions, a structured questionnaire was developed. The questionnaire was organized into four thematic sections: the first focused on the entrepreneur, the second explored characteristics of the business entity, the third examined aspects of EE and the fourth investigated processes related to EL. Regarding the EE questions, specifically those assessing entrepreneurial characteristics that have improved and outweigh the desire for further improvement, research by Passaro et al. (2017) and Ekanem (2015) were taken into account. All EE questions were developed based on the relevant theoretical framework outlined in the introductory section. Similarly, EL questions were derived from the corresponding theoretical framework. For instance, based on the theory of learning from a mentor (Allen et al., 2004, Wanberg et al., 2006), a question was formulated to assess whether the sample entrepreneurs had learned from someone who acted as a mentor. Similarly, each theoretical source informed the development of related questions for the EL sources in the sample. The majority of responses were on a Likert scale (1-5) for disagree/agree respectively.

3.3 Sampling

Beginning with the business perspective, our sample includes 512 businesses with 91% of the total having been in operation for 43 months or more. The sector classification was detailed enough to accurately represent all types of businesses. Respondents selected from seven categories; commerce, construction, manufacturing, transport and storage, production, tourism, and services, allowing for a comprehensive depiction of their business activity. Finally, the sectoral distribution of respondents shows that 21.7% operate in the commercial sector, 24.8% in tourism and 32.2% in services (the remaining percentage is distributed in other categories).

Regarding the distribution of enterprises in the island clusters, there was uniformity in terms of representation, corresponding to the number of enterprises. The larger island clusters had a larger sample representation in the survey results. For example, the Cyclades and the Dodecanese, where the largest number of enterprises were concentrated, had respectively 34.2% and 27.1% representation. The same continues with 21.9% from Chios, 11.7% from Lesvos and 5.1% from Samos. Regarding the legal form, 51.8% of the sample are personal businesses. Only 6.4% were limited liability companies, and also the majority have only one owner (52.9%). Concerning the

size of businesses, 71.9% have an annual turnover of 0-500.00€ and 85% employ 0 to 9 employees. These results show us that we are dealing with small enterprises.

Recognizing the entrepreneur as the core of entrepreneurial activity, the profile of the entrepreneurs who participated in the survey is captured here. Our sample consists of 512 entrepreneurs, 164 women and 348 men. The majority of our sample is 33.6% in the age group 45 to 54. Regarding marital status, 73% are married and almost half of the sample (42%) are graduates of higher education. Only 84 out of 512 (16.4%) had previous business experience (as an owner). Reasons for previous unsuccessful experience were given by most of them as reasons for market turbulence and inability to access sources of finance. 71.1% are owners of only one business (the one for which they are responding) with 88.5% having this business as their main source of income. Regarding the reasons for entrepreneurial engagement, 18.9% inherited their business, while the majority (35.4%) chose entrepreneurship for self-employment. Almost all entrepreneurs (65.3%) enjoy their profession, with another 56.7% pursuing business for professional independence, and 59.8% choosing entrepreneurship for a better lifestyle. Almost all the sample considers their experience as entrepreneurs important (87.2%).

4. Findings

Although respondents initially provided answers using a 5-point Likert scale, where 1 indicated not at all and 5 indicated absolutely, to generate more interpretable results, all responses were recoded into three categories: negative (combining responses 1 and 2), sufficient (response 3), and positive (combining responses 4 and 5).

To assess the level of EE among entrepreneurs, the study examined several key factors: the entrepreneurs' educational attainment, their knowledge of core business concepts, participation in empowerment or training programs, and their expressed willingness to engage in further EE. In order to investigate the business level of the respondents in terms of basic knowledge of key business terminologies, they were asked about their knowledge or experience with concepts such as business plan, canvas and others presented in the table below.

Table 1: Level of knowledge/experience of entrepreneurial concepts

Entrepreneurial Concepts	Negative	Sufficient	Positive
Business plan	29.3%	28.5%	42.2%
Business model canvas	68.9%	14.6%	16.4%
Pitching	54.7%	21.7%	23.6%
Networking	37.9%	29.9%	32.2%
Public Speaking	51.6%	20.3%	28.1%
Marketing plan	47.3%	27.1%	25.6%
New product development	50.4%	25.8%	23.8%
Development of new markets	54.1%	24.4%	21.5%

To evaluate the extent of entrepreneurs' prior participation in training programs aimed at enhancing their EE, respondents were asked a dichotomous (yes/no) question regarding their involvement in such programs. The vast majority of the sample responded with 79.7%, that they had attended training programs (either from Universities or other institutions).

Furthermore, respondents who indicated prior participation in training programs were subsequently asked to specify the business competencies addressed during the training and to evaluate the practical impact of this training on their daily business operations. Drawing upon relevant theoretical frameworks and established business practices that are amenable to enhancement through education, participants provided insights into which entrepreneurial skills and attributes were developed as a result of the programs, as well as the degree to which these improvements influenced their business performance. Particularly, they responded that these programs helped to enhance critical thinking by 40%, self-confidence by 38.2%, improved organization by 37.5%, and improved customer service by 37.4%. The results are presented in Figure 1.

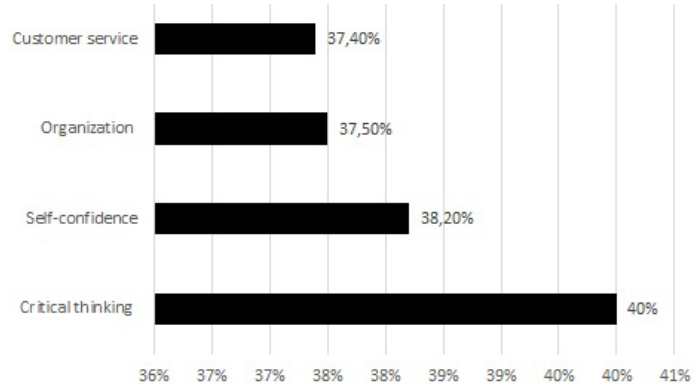


Figure 1: Entrepreneurial skills improved after EE programs

Finally, concluding the entrepreneurship education, the entrepreneurs were asked which aspects they would like to strengthen, giving a comprehensive overview of the future of entrepreneurship education in enterprises and the areas that need training. Specifically, exactly the half (50.4%) answered that they would like to be trained on improving business performance and 49% on business development. Then, 43.8% said they would like training regarding improved organization and 43.4% training on innovation. Moreover, 42% reported a desire for training on proper customer service and with 40.2% on personnel management and marketing strategies. Figure 2 illustrates the results.

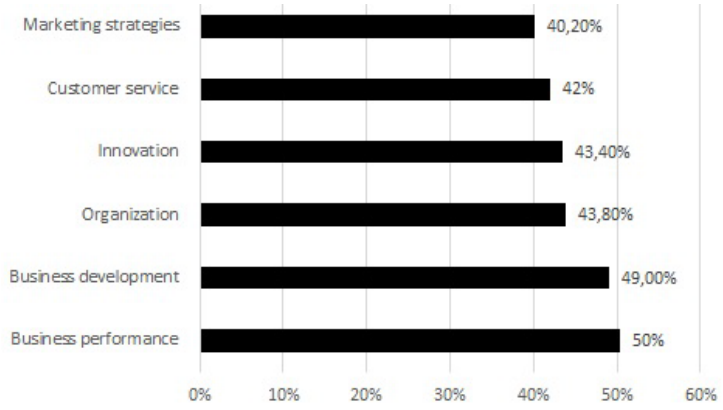


Figure 2: Entrepreneurial skills to be improved through EE programs

Moving from EE to EL, we present the results of EL, particularly where our sample derives additional business knowledge from, beyond the formal ways of learning. Starting with experiential learning, respondents were asked to answer on a preference scale whether they had acquired experiential knowledge. The table below shows the response rates to the aspects that constitute empirical knowledge, namely knowledge from everyday business activities, knowledge from accumulated business experience, and knowledge derived from positive and negative results of previous dealings.

Table 2: Level of experience-based learning

Experiential Learning	Negative	Sufficient	Positive
Everyday entrepreneurial activities	4.3%	23.9%	71.8%
Accumulated business experience	5.9%	23.2%	70.9%
Positive and negative results of previous experiences	6.5%	24.4%	69.1%

Entrepreneurial knowledge in our sample also comes from someone acting as a mentor. Specifically, 52.6% of the sample reports that they have received additional EL from someone with more entrepreneurial experience than them, transferring knowledge and/or resources to them.

From the related theory of entrepreneurial learning through observation, our sample has gained additional knowledge from observing partners (suppliers and customers) and from observing other firms/entrepreneurs.

The answers to the respective questions are presented with the corresponding percentages in the following table.

Table 3: Entrepreneurial knowledge from observation

Observation of	Negative	Sufficient	Positive
Parents	43.5%	22.7%	33.8%
Friends	50.2%	32.4%	17.4%
Old schoolmates/alumni	77%	15.6%	7.4%
Partners (suppliers, customers)	33%	35%	32%
Other enterprises/entrepreneurs	32.6%	34.4%	33%

Regarding further entrepreneurial learning from networks, 38.1% of the entrepreneurs in the survey consult networks of other businesses and entrepreneurs and 31.5% consult networks of partners and colleagues for additional information.

5. Discussion

Considering the results for EE, and specifically the knowledge of entrepreneurial concepts, we see that the majority of entrepreneurs have less knowledge of other entrepreneurial concepts beyond the term business plan. This shows that most entrepreneurs approached the establishment of their enterprises with a structured vision for existence, rather than merely initiating business activity without direction. However, the overall understanding of core entrepreneurial concepts presents a less optimistic picture. Despite the fact that the majority of the sample has been engaged in entrepreneurial activity for more than three years, a significant portion lacks knowledge of foundational tools such as the Business Model Canvas and the marketing plan.

Nevertheless, despite the lack of conceptual knowledge, we notice that entrepreneurs are interested in training themselves through attending educational programs, and the participation rate (79.7%) in these indicates that there is EE in our sample. Complementarily, these have effectively helped in improving skills such as developing critical thinking, self-confidence, organization and customer service. Also, the last pillar of EE measurement reveals that entrepreneurs want to enhance EE. In addition to the expected responses for training in economic development and general business improvement, entrepreneurs are keen on learning about innovation and marketing strategies. This shows that they understand that the business world is evolving and moving forward and their need for training in these areas shows that they do not want their businesses to be left behind but to keep up with the new entrepreneurial reality.

Giving answers to EL, we see that the vast majority learn through business experience and more specifically from accumulated business experience, day-to-day operations and positive and negative results of previous experiences. Regarding the theory of learning through observation of persons, our sample verifies additional knowledge from observation of co-workers as well as other businesses and entrepreneurs. Finally, our results also verify the theory of learning from networks (especially from parents and other enterprises).

Overall, in response to the first research question and how EE is reflected among firms and entrepreneurs operating in regionally decentralized economic areas, EE demonstrates a notably high standard of performance. This is demonstrated both by their knowledge and entrepreneurial skills improvements through entrepreneurship programs and their willingness to further EE. Despite the positive results, however, the need for more entrepreneurship education shows that in remote areas EE requires improvement. Regarding the second research question and the impact of EL in the sample firms, the additional entrepreneurial learning that comes from non-formal education in our sample is particularly strong. To conclude, it is noticeable that the rates of entrepreneurial learning and in particular EL from experience are overwhelmingly higher than the others and compared to those of EE. Consequently, it can be inferred that EL is more developed in remote areas such as those in the sample, but this does not exclude the existence of EE through formal learning providers.

6. Conclusions and Implications

As shown by both theory and research findings, the concepts EE and EL differ. On one hand, EE involves engagement with formal education, provided by Universities or other institutions. On the other hand, EL is parallel learning with entrepreneurial activity through non-formal means such as practical experience,

observation, and participation in professional networks. Despite the distinction and comparison of the concepts, EE and EL should be conceptualized as a dual-track process, particularly in the case of entrepreneurs committed to the sustainable growth and responsible management of their enterprises. Only through this combined path can an entrepreneur remain well-informed, maintain an open and perceptive view of the daily and multifaceted demands of business activity, and be adequately equipped to adapt to challenges and needs that arise.

The results shed light on the nature of EE and EL in areas remote from major urban centers. They reveal the current reality of the level of EE and additional ways of learning entrepreneurship. Moreover, the EE and EL principles are implemented horizontally within the enterprise and may have a fundamental implication in social entrepreneurship.

7. Limitations and Opportunities for Future Research

This research was conducted in a specific region, away from major urban centers and the capital. Future research would replicate the survey in mainland Greece and continental areas to explore differences in EE and EL, especially in urban centers where knowledge and information are more accessible.

Ethics Declaration

Ethical clearance was not required for the research.

AI Declaration

No AI tools were used to create the content. AI was used solely to paraphrase expressions for accurate and formal English presentation, including text insertion and transcription where needed.

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Advancement of Blockchain Technology for Innovation and Efficiency in Business Models

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Abstract: The augmenting business advancement and the advent of Artificial Intelligence build the business process to develop novel ways of collaboration. Digitalization of business is fostered and data privacy can be provided through blockchain technology. Blockchain enhances security, trust, transparency, and instant traceability among employees. It utilizes a shared and static ledger with the members of a business process who have permission for its access. It reduces errors, and paperwork, and minimizes overheads and transaction costs. It eliminates the requirement of middlemen to verify transactions. Thus, it contributes to cost savings by improving the efficiency, speed, and automation of business processes. The application of Blockchain has continuously evolved since its first inception in cryptocurrency. This paper is based on the innovation and efficiency provided through the introduction of blockchain technology to innovative business models. The research surveys literature to obtain a comprehension of the opportunities provided by blockchain in enhancing business. It bestows altering and upgrading business models to the needs of customers, suppliers, and competitors. The study suggests that the combined impact of Artificial Intelligence, the Internet of Things, and Sensing Technology with blockchain has the prospects to provide remarkable benefits to the business. Its ingenuity empowers organisations to work with their business partners in a protected environment. It provides numerous incentives to transform consumers into blockchain business models. Employing blockchain technology in business models facilitates the application of cryptography and tokenization. Start-up firms use initial coin offerings (ICOs) to generate investments through crowdfunding of these token-based ecosystems. This research would assist organisations in innovating their business models through the implementation of blockchain technology and enhance efficiency, security, and transparency in their business.

Keywords: Blockchain Technology, Business Models, Innovation, Efficiency

1. Introduction

Over the last few years, increasing applications of blockchain technology have emerged in business models. Blockchain is a distributed ledger that utilizes cryptography to link the blocks of data (Shueb et al. 2024). All the parties involved have control over data rather than just a single business resulting in a decentralized system. Blockchain is tamperproof and operates on a peer-to-peer network of data. The application of blockchain technology has proliferated across diverse industries including finance, logistics, automotive food, and beverage. The conception of a full-fledged blockchain business model is unexplored yet. The development of blockchain business models is majorly attributed to the start-ups facilitating the dissemination of the technology (Grünewald et al. 2024). Gaming and financial industries are employing tokenization and blockchain in their business models. Blockchain technology has been relevant in logistics and supply chain management however, it seems less employed than in financial applications. Blockchain technology assists in data automation and financial flows in supply chain management. It has remodelled the business by enhancing security, transparency, and efficiency in business models (Bafghi2024).

Blockchain contributes to the notion of participation-based value creation. The complete network of partners avails the benefit of the value network rather than a privileged group of stakeholders (Ghobakhloo et al. 2024). The transparency and traceability feature of blockchain technology allows stakeholders and supply partners to comprehend the socio-environmental performance of operations, raw materials, and products. Blockchain technology facilitates inventory management and order fulfilment by optimizing the distribution of materials and products (Mishra and Jain 2024). Despite that, the proliferation of blockchain technology is in the nascent stage. The implementation of this technology is still quite challenging for businesses.

Implementing blockchain technology has to be accomplished in a network to explore its full potential. Business nowadays operates in cross-enterprise networks (Ding et al. 2024). A dynamic and cross-company configuration of competencies and resources is defined as Enterprise networks. Thus, the effect of one business impacts all the other business partners within the enterprise ecosystem. So, the business has to consider the intrigue, requirements, and challenges related to the associated partners. The business models undergo a drastic

transformation with the implementation of blockchain technology (Salama et al. 2024). The enterprise network partners also transform their business models. The synergy of technical feasibility with developing appropriate business models is crucial for implementing blockchain technology. Blockchain can augment technologies such as Artificial Intelligence and the Internet of Things (Gupta and Singh 2024). It enhances waste reduction, material efficiency, and emission prevention, thus optimizing the manufacturing process.

The study addresses the following research question:

Research Question: How does blockchain technology assist in developing innovative and efficient business models?

By exploring the advancement of blockchain technology, the study aims to comprehend its impact on developing innovative and efficient business models. By acknowledging the role of blockchain technology, the study provides valuable insights into the role of blockchain technology in enhancing security, transparency, and efficiency in business models.

2. Literature Review

Blockchain technology is a decentralized, distributed ledger technology. It records transactions over multiple computers transparently, securely, and tamper-proof (Dong et al. 2023). This technology permits peer-to-peer transactions and obliterates the requirement of intermediaries. It offers a decentralized computer network, eliminating the risk of failure of central points. It is immutable, and the data once stored on the blockchain cannot be modified or deleted which assures transparency in data and prohibits fraud. This technology promotes transparency in transactions, enhancing accountability and trust among all network participants (Ahmed 2025). It enhances the security of transactions using cryptographic techniques, preventing hacking and unauthorized use of data.

The prominent use cases for blockchain are cryptocurrencies like Ethereum, Bitcoin, and similar digital currencies. It promotes decentralized borrowing, lending, and trading through decentralized finance (DeFi) (Makarov and Schoar 2022). It also supports supply chain management by tracking products from source to destination with transparency. It contributes to the healthcare sector by augmenting data sharing and protecting records of patients. It corroborates voting systems through tamper-proof digital elections (Shuker and Hussain 2024).

Blockchain technology is classified into four types including public blockchain, private blockchain, consortium blockchain, and hybrid blockchain (Audu and Shabih 2024). In the public blockchain, anyone can access, validate, and participate as it is open and decentralized (Witts et al.2024). It is used by cryptocurrencies like Ethereum and Bitcoin, decentralized finance (DeFi) platforms like Uniswap, and Non-fungible tokens (NFT) marketplaces like OpenSea. Private blockchains provide control to authorized participants. They get access to the network and validate transactions (Yang et al. 2024). It is used in enterprise solutions like supply chain tracking, banking, and finance, like RippleNet for cross-border payments, and healthcare, to securely store patient records.

Consortium blockchain is controlled through multiple organizations. A group of predefined participants can validate transactions here (Geng et al. 2024). It is used in banking and finance, like R3 Corda, for secure transactions by banks. A hybrid blockchain is a synergy of private and public blockchains. It keeps a few data public with controlled access (Negi et al. 2024). It is used in healthcare, securely share patient records between hospitals.

The revolution of blockchain technology fosters innovation in traditional business models. It eliminates the requirement of intermediaries like brokers, banks, and third parties by providing peer-to-peer connections, thus decreasing cost (Bakare et al. 2024). The blockchain technology provides secure and authorized transactions. It allows for the formation of smart contracts, automating processes and agreements in business. This minimizes the overheads, increasing the efficiency of the business model (Ye et al. 2024). This technology benefits sectors like real estate, finance, and supply chain management with speedy and secure transactions.

Blockchain technology is facilitating businesses with tokenization. Assets like stocks, real estate, and art can be tokenized to entitle fractionalized ownership and liquidity, thus revamping investment and augmenting crowdfunding (Guggenberger et al. 2024). This technology enhances efficiency and safety in the supply chain by boosting transparency and real-time tracking of products. Blockchain promotes decentralized autonomous organizations (DAO), which revokes central authority, leveraging community-driven decision making where governance is driven by stakeholders (Bonnet and Teuteberg 2024).

Blockchain technology has introduced non-fungible tokens (NFTs), which are assets like digital content, video, or a piece of art tokenized through blockchain (Damodaran 2024). The assets are stored in one place, and these tokens are stored on a blockchain. These NFTs generate novel business opportunities in digital art, gaming, and entertainment. These NFTs offer ownership proof to digital assets. Blockchain offers decentralized finance (DeFi), providing financial services like borrowing, lending, and insurance without the involvement of traditional banks (Singh, 2024). The risk of cyber threats is minimized through decentralization and encryption of data using blockchain technology.

3. Methodology

This study follows a hybrid approach to a systematic literature review through qualitative and quantitative analysis. A quantitative analysis is carried out on all selected papers. A qualitative analysis is performed on the top-cited papers. The methodology selected to attain the final papers is the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) technique. It is a process of systematic literature review involving four stages: (a) identification, (b) screening, (c) eligibility, and (d) inclusion. Through this technique, the most pertinent papers can be discovered.

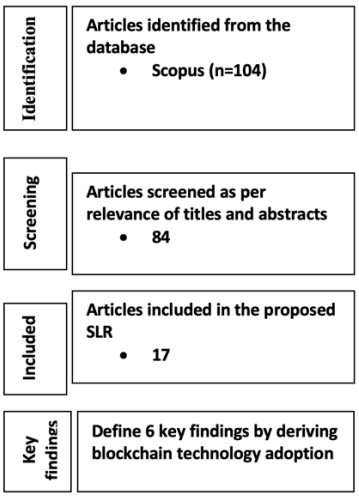


Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram for the proposed systematic review.

The database used for this purpose is Scopus, which covers over 89 million records covering book series, journals, conference proceedings, and cited references. The right keyword selection is the criterion to view the maximum related articles in the area. The following list of queries was used to search the literature related to this study. The terms used in the search were “blockchain technology adoption”, “efficiency”, and “innovation”. Query Terms: “Efficiency” OR “Innovation” AND “Blockchain Technology Adoption.” The PRISMA guidelines were incorporated to establish whether an article met the inclusion criteria (Figure 1), and the irrelevant articles were excluded.

Table 1: The seven most cited articles on Blockchain technology enhancing efficiency and innovation in business models.

Author(s)	Article Title	Journal, Year (Citation)	Key Findings
Saurabh and Dey	“Blockchain Technology Adoption, Architecture, and Sustainable Agri-food Supply Chains.”	Journal of Cleaner Production, 2021 (371)	BCT can improve the agri-food supply chain efficiency and quality management
Toufaily et al.	“A Framework of Blockchain Technology Adoption: An Investigation of Challenges and Expected Value.”	Management, 2021 (251)	Innovation is the most trending technologies in the ecosystem.
Ullah et al.	“Blockchain Technology Adoption in Smart Learning Environments”.	Sustainability (Switzerland)< 2021 (135)	BCT is aiding decision makers in building smart learning environment for the educational institutes.

Author(s)	Article Title	Journal, Year (Citation)	Key Findings
Valeri and Baggio	"A Critical Reflection on the Adoption of Blockchain in Tourism."	Information Techonology and Tourism, 2021 (129)	BCT can assist in treating operational problems in transactions, contracts, sales, payments, and supply chain in tourism.
Bhardwaj et al.	"Determinants of Blockchain Technology Adoption in Supply Chains by Small and Medium Enterprises (SMEs) in India."	Mathematical Problems in Engineering, 2021 (110)	BCT adoption is aiding supply chains in cost optimisation, effective record-keeping, transparency, and route tracking.
Nayal et al.	"Antecedents for Blockchain Technology-enabled Sustainable Agriculture Supply Chain."	Annals of Operations Research, 2023 (90)	BCT positively influences sustainable agriculture supply chain performance through its innovative capabilities.
Munim et al.	"Assessing Blockchain Technology Adoption in the Norwegian Oil and Gas Industry Using Bayesian Best Worst Method."	Journal of Industrial 2022 (64)	BCT can assist oil and Information Integration, gas industry for operational excellence.

Source: Accessed on 2 April 2025 (Scopus database)/ compiled by the authors.

4. Results and Analysis

Adapting the PRISMA technique, the advancement of blockchain technology in enhancing the efficiency and innovation in business models has been studied. Table1. presents the top seven most-cited articles relating to the role of blockchain technology.

Lou and Li (2017) investigated the intention to adopt blockchain technology. The study explored the application of this technology in Bitcoin, a cryptocurrency, and the building of smart contracts as offered in Ethereum. It would assist in a financial firm's performance through reconciling multiple ledgers, thus enhancing operational efficiency. It's decentralized, and encryption prevents data breaches. It aids in designing smart contracts that execute only after meeting risk conditions (Okaily 2025).

Hidayanto and Prabowo (2019) explored the application of blockchain technology in supply chain management. The study probed the impact of technology in reducing costs and improving services. The application of blockchain technology would foster future developments, incorporating cost reduction, standardization, regulation system development, platform development, and talent cultivation in supply chain management capabilities (Duan et al.2023). The supply chain capability of the industry concerned with integrity issues like halal food benefits from blockchain technology. Competitive pressure, top-management support, external support, and triability are some factors for blockchain technology adoption (Ali et al. 2024).

Darabseh and Martins(2020) have delved into the adoption of blockchain technology in the AECO (Architecture, Engineering, Construction, and Operations) sector. This technology has improved to expand, store and share construction data more efficiently. Blockchain technology has supported the construction industry by developing smart construction projects, enhancing collaboration, efficiency, and transparency through decentralized data management. Adopting this technology nurtures the sustainability of the construction projects (Alawag et al. 2024).

Duy et al. (2018) explored the opportunities and challenges of blockchain adoption. It highlighted the disruption the technology would bring in sectors like healthcare, intellectual property, insurance, financial payments and education. Bhadoria et al.(2022) examined the scope of blockchain technology in the e-voting system. The paper demonstrates its application in maintaining transparency, immutability, and end-to-end verifiability to assure fair elections. The three organisational capabilities, namely technological capability, innovation capability, and information-sharing capability, facilitate blockchain technology adoption. This enhances the firm's performance, inducing competitiveness and sustainability of electronics companies (Polas et al. 2025).

The following list of key findings is presented after the analysis of the 17 articles on adoption of blockchain technology:

Key finding 1: Blockchain technology has applications in cryptocurrency and building smart contracts.

Key finding 2: Blockchain technology assists in the performance of financial firms.

Key finding 3: Blockchain technology enhances supply chain capabilities.

Key finding 4: Blockchain technology has supported the construction industry.

Key finding 5: Blockchain technology is facilitating an e-voting system.

Key finding6: Blockchain technology improves the performance and sustainability of electronics companies.

The papers analysed above support the research question that blockchain technology assists in developing innovative and efficient business models by enhancing supply chain capabilities, cost reduction, trustworthiness, fraud detection, decentralization, reconciliation of multiple ledgers, inducing competitiveness, and sustainability.

5. Discussion

The analysis of existing literature shows that blockchain has moved beyond cryptocurrencies and now applies to multiple sectors, including supply chain, construction, finance, healthcare, and governance. The adoption of decentralized ledger systems has become widespread due to their capability to boost data security, reduce fraud incidents, and offer tamper-proof records. These features help organizations increase operational effectiveness while creating opportunities to transform their business models. Smart contracts, together with tokenization, have revolutionized traditional business operations by enabling automated, trustless transactions that lower administrative costs and eliminate third parties.

Businesses within the financial services and supply chain sectors show the highest adoption rates of blockchain technology, as these industries require secure, real-time verification of data and audit trails. The healthcare sector is incorporating blockchain for storing electronic health records, which assures patient ownership and data integrity. It is employed in fitness tracking by providing the users control over their fitness figures. Fintech has incorporated blockchain by building smart contracts for automating financial agreements. Blockchain provides decentralized finance, offering investments, insurance, and loans without the need for intermediaries. It has been adopted in the food industry to enhance transparency in the supply chain from farm to retailer and build customer trust by showcasing the complete food journey. Ripe.io develops blockchain-based food solutions focusing on a trusted digital supply chain, enhancing the quality and safety of food. Sectors like construction and education are currently at the experimental stage. Blockchain technology is increasingly being integrated with Artificial Intelligence (AI), the Internet of Things (IoT), and sensing technologies to develop integrated digital ecosystems. However, interoperability issues, system integration challenges, and data governance concerns arise as a result of this technological convergence.

Blockchain is contributing to software development by providing decentralization, trust, and security. The incorporation of digital signatures provides only the private key holders to authorize transactions. High-value transfers are assisted by time locks and multi-signature wallets. Decentralization facilitates each node to have access to a copy of the ledger, administering no sole point of control or failure. The users don't require any information about each other instead, the smart contracts ensure trusted execution. Smart contract, once deployed, follows its code conclusively, and thereafter, there is no manual intrusion. The smart contract code and transactions are publicly thus anybody can audit flows and balances. Smart contracts powered with zero-knowledge guarantee undisclosed logic and transactions.

Barriers to adoption include undefined regulatory standards, scalability concerns, energy efficiency challenges, and the capital expenses required for infrastructure upgrades. Small and medium-sized enterprises (SMEs) face significant constraints that may prevent them from implementing blockchain despite understanding its long-term advantages. The reviewed literature shows that blockchain has gained widespread strategic importance among firms seeking competitive advantage through transparent operations, efficient processes, and innovative practices. Research indicates that blockchain understanding has progressed to a new stage, prompting organizations to embrace its enterprise-level implementation across industries.

5.1 Theoretical Implications

The research provides substantial theoretical insights into how blockchain technology transforms business models by achieving better operational efficiency, transparency, and innovation. Blockchain functions as an

enabling system for decentralized trust and secure data management, as supported by the literature, which highlights its role in building contemporary business frameworks. The research supports and expands the diffusion of innovation theory, the technology acceptance model, and the resource-based view by identifying blockchain's strategic contribution to competitive advantage.

Blockchain technology demonstrates theoretical applicability across supply chain management, healthcare, construction, and finance sectors, indicating its potential for industry-wide implementation. The development of smart contracts and token-based ecosystems enables peer-to-peer transactions and Decentralized Autonomous Organizations (DAOs) to operate through decentralized governance structures. These theoretical foundations establish a basis for studying blockchain not only as a technological tool but also as a factor capable of revolutionizing business and institutional systems.

5.2 Practical Implications

The examined studies reveal that blockchain technology enables businesses to decrease operational costs while accelerating transactions by removing intermediaries. Supply chain management benefits from increased transparency, as blockchain allows for real-time tracking across the agricultural, pharmaceutical, and logistics industries. With its data protection features, organizations can defend against cyber threats through encryption and tamper-proof mechanisms. Smart contracts automate various business operations, reducing the need for human monitoring and improving operational efficiency. Startups can leverage blockchain technology for decentralized fundraising through Initial Coin Offerings (ICOs). Overall, blockchain technology serves as a transformative system that delivers operational efficiency, cost reduction, and enhanced transparency and trust—benefiting both established firms and emerging ventures.

6. Conclusion

This research demonstrates that blockchain technology is an essential tool for modernizing both traditional and digital business models. A systematic analysis of 104 academic articles was conducted to investigate blockchain's impact on innovation, security, efficiency, and decentralization within business ecosystems. The PRISMA method enabled the identification and assessment of highly cited studies that underscore blockchain's value across various industries.

Findings show that blockchain facilitates the reconciliation of multiple ledger systems, automation of smart contracts, transparent supply chain operations, and improved cybersecurity. Its relevance is evident in sectors such as construction and e-governance, where it supports smart infrastructure development and secure digital elections. Collectively, the evidence confirms that blockchain adoption enables businesses to become more agile, secure, and customer-centric—laying a foundation for sustainable competitive advantage.

7. Limitations and Future Research Directions

While the study provides a comprehensive overview of blockchain implementation, its findings are limited by the exclusive use of the Scopus database. Future research should expand the scope by incorporating academic sources from Web of Science, ProQuest, DOAJ, EconLit, and EBSCO to improve the generalizability and inclusiveness of results. This approach would allow for more region-specific and context-sensitive research.

Additionally, this research is conceptual and literature-based. Future studies should empirically validate blockchain-based models through primary data collected from organizations that have adopted such technologies. Research should also explore the sustainability and energy efficiency of blockchain solutions in greater depth. Special attention must be given to startups and SMEs, which face unique barriers compared to larger corporations. Finally, interdisciplinary studies examining the legal, ethical, and environmental dimensions of blockchain adoption would contribute to a more holistic understanding of its long-term impact.

Ethical Declaration

This study involved no human or animal subjects and adhered to ethical research standards. All sources used are publicly available or properly cited.

AI Use Declaration

AI tools were used only for language editing. All ideas, analysis, and interpretations are the authors' own.

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A Clash of Paradigms: Hidden Paradigms Within Entrepreneurship Pedagogy

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Abstract: As the literature around entrepreneurship pedagogy matures and the number of entrepreneurship programmes continue to flourish, we see a clash of paradigms that hide assumptions about what success is and how success is internalised as an internal cognitive schema. This has implications for the way entrepreneurship is viewed by stakeholders, how behaviour success is measured and how it is taught to aspiring students. The goal of this paper is to examine two contradicting paradigms we propose underlie much of existing entrepreneurship pedagogy. Based on existing literature, this paper develops and draws on two main extreme alternative entrepreneurship approaches that is found in literature: The individualistic competitive approach (i.e. often populated by Individuals with problematic narcissistic tendencies) versus the collectivist team-based approach (i.e. embedding extensive psychological safety and a collectivist logic). The previous approach in some of the literature, have been proposed to give superior outcomes in terms of economic measures. More recent research however questions this approach and its outcomes. Among others, the dependent variables on which the more individualistic research orients do not account for the wider set of value(s) that mission-driven and sustainable entrepreneurship build. As such, the two approaches represent different paradigms of entrepreneurship and what entrepreneurship is about. The paper uses existing literature and document analysis of the entrepreneurship programme descriptions at the master level across Europe, Asia and the US. We classify the dominance of the different approaches across programmes and geographies using online available descriptions from the university's sites. As such, we develop insights into the underlying values and assumptions on which the programmes are based and the consistency of their learning outcomes, given their orientation. The findings illustrate that both paradigms are found in most entrepreneurship programmes, but with different emphasis, while at the same time addressing the difficulties of integrating the two paradigms in the same educational programmes.

Keywords: Entrepreneurship, University, Innovation, Higher Education, Critical Pedagogy, Curriculum Analysis

1. Introduction

Beliefs in entrepreneurial success has since the start of 2025 been thrust upon global politics as Elon Musk entered a central role in the American Presidency. As a result, the logic of entrepreneurship is heavily impacting societal decisions far beyond Silicon Valley. The underlying logic of the governing bodies of the US will be the centre of the research that will be presented below. We consider two alternative divergent paradigms of entrepreneurship: the individual versus the collective, and the values that underpin entrepreneurial activity (Neck & Greene, 2011; Fayolle, 2013). These logics carry epistemological and pedagogical consequences that shape how entrepreneurship is taught, what behaviours are valorised, and how aspiring entrepreneurs internalize success.

Further, in a world where there is need for sustainable oriented businesses, the focus on the need for alternative approaches and conceptualizations and understanding of value creation is essential. Under an individualistic and economic notion of entrepreneurship this is difficult to achieve.

While entrepreneurial activity traditionally did not take place in educational institutions, this has changed since the 2000s, where entrepreneurship has become a future skill and part of university curriculum globally. To study the underlying paradigms of entrepreneurship and their dominance, we therefore use the curricula of entrepreneurship education as a starting point. We look at the most innovative universities globally based on the WURI2024 (Global Top 300 Innovative Universities) ranking to map how the logics are expressed and the degree to which they dominate. Our aim is to develop an understanding of the degree to which the logics compete and are distinct or take a more integrated form. As a starting point for our research, we ask the following research question: How are different entrepreneurship paradigms and their resulting logics integrated into entrepreneurship programmes across universities and geographies?

By interrogating these paradigms and their interlinked logics and analysing how they manifest across educational programmes, this paper contributes to a deeper understanding of the normative and ideological assumptions

embedded within entrepreneurship education. It also offers insight into how these paradigms shape learning outcomes and the entrepreneurial identities students come to adopt.

2. Theory

2.1 Competing Paradigms: Individualism Versus Collectivism in Entrepreneurial Logic

Two broad paradigms can be identified in the entrepreneurship literature. The first, an individualistic-competitive paradigm, aligns with neoliberal and market-driven logics of entrepreneurial action (Ahl & Marlow, 2012; Berglund & Verduijn, 2018). This paradigm emphasizes personal ambition, competitive drive, risk-taking, and the cultivation of a strong entrepreneurial identity—traits that align with what has been described as a "heroic" or "lone wolf" model of entrepreneurship (Anderson & Warren, 2011). Such portrayals often neglect the social, relational, and contextual dimensions of entrepreneurship, instead privileging traits commonly associated with charismatic or even narcissistic individuals (Mathieu & St-Jean, 2013; Baldegger & Gast, 2016). Entrepreneurial success, in this paradigm, is typically measured through economic outcomes such as venture growth, financial performance, and scalability (Shepherd et al., 2019).

In contrast, we highlight a second paradigm, which can be termed collectivist-collaborative, that emphasizes relational embeddedness, team-based learning, psychological safety, and shared value creation (Johannisson, 2011; Pittaway & Cope, 2007). Drawing on pedagogies of collaboration and experiential learning, this paradigm aligns with humanistic and constructivist educational philosophies (Gibb, 2002; Rasmussen & Sørheim, 2006). In this paradigm entrepreneurship is conceived as a process that emerges within networks and communities, oriented toward mutual benefit, social innovation, and sustainability (Neck et al., 2014; Jones & Matlay, 2011). This paradigm places greater emphasis on inclusivity, reflexivity, and mission-driven value creation, and is thus more attuned to emerging forms of sustainable and social entrepreneurship (Chell, 2007; Shepherd & Patzelt, 2011).

2.2 Problematic Consequences of Paradigmatic Tensions

While both paradigms offer legitimate perspectives, their coexistence can create problematic tensions—both pedagogically and epistemologically. The individualistic-competitive paradigm can foster an exclusionary view of entrepreneurship that marginalizes those who do not conform to dominant entrepreneurial archetypes (Bruni et al., 2004; Essers & Benschop, 2007). Often utilising instructional approaches that emphasize competition, performance metrics, and real-world pressure simulations such as pitch competitions, business plan contests, and accelerator-style programming (Hägg & Gabrielsson, 2020). Moreover, it may cultivate environments of psychological insecurity and excessive performance pressure among students, reinforcing values that reward competition over collaboration (Jones et al., 2012).

On the other hand, the collectivist-collaborative paradigm, offers a more inclusive and socially responsive view, focussing on dialogue, critical reflection, peer learning, and affective engagement—components that support the development of psychological safety and collective efficacy (Rideout & Gray, 2013; Jones, Matlay, & Maritz, 2012). This may be undervalued in institutional settings that prioritize short-term measurable outcomes and economic impact, thus leading to potential dissonance between pedagogical intent and institutional reward structures (Neck & Corbett, 2018; Rideout & Gray, 2013).

While both paradigms are often present across entrepreneurship programmes, their coexistence often produces tensions that are rarely acknowledged explicitly in curricula (Blenker et al., 2012). The simultaneous presence of both paradigms in educational programmes—often without explicit articulation—can result in curricular incoherence, mixed messages, and confusion for students (Blenker et al., 2012). Instructors may promote psychological safety in one module, while subjecting students to zero-sum competition in another, inadvertently undermining the values they intend to foster. Without a critical interrogation of the paradigmatic foundations of entrepreneurship education, such contradictions remain unresolved and potentially damaging to student learning and identity development.

2.3 Internalization of Entrepreneurial Success

A key concern that arises from these paradigmatic tensions is how students internalize the notion of success. Under the individualistic paradigm, success is narrowly defined through external, often financial metrics, potentially leading to internalized pressure, self-comparison, and exclusionary conceptions of legitimacy (Essers

& Benschop, 2007; Bruni, Gherardi, & Poggio, 2004). The collectivist paradigm, in contrast, promotes a broader and more inclusive understanding of success, integrating personal growth, social contribution, and ethical responsibility. We know that different cultures view each paradigm differently (Thetsane, Meyer, & Chambwe, 2024), and as the world becomes more globalised the institutionalization of entrepreneurship education often reinforces dominant colonial logics that privilege measurable economic outcomes, even when alternative values are espoused rhetorically (Omodan, Manquma & Mafunda, 2024; Hytti & Heinonen, 2013).

2.4 The Hidden Nature of Paradigms and Educator Blind Spots

A central challenge in addressing these paradigms is their often implicit and taken-for-granted nature. Paradigms act as lenses through which educators interpret entrepreneurship and legitimate certain forms of knowledge, behaviour, and success while rendering others invisible (Kuhn, 1970; Blenker et al., 2012). Because these paradigms are rarely made explicit in course design or institutional documentation, educators may unknowingly reproduce organisational logics without critical reflection. For example, educators trained within neoliberal academic systems may instinctively design learning environments that reward individual performance, competition, and pitch-based assessments, believing these to be pedagogically neutral or universally applicable (Berglund & Verduijn, 2018; Ahl & Marlow, 2012).

This uncritical reproduction of paradigms may stem from a lack of engagement with alternative conceptions of entrepreneurship or insufficient pedagogical training (Fayolle, 2013). If educators do not reflect on their own assumptions—about what entrepreneurship is, what counts as success, and how entrepreneurial capability should be developed—they risk engaging in what Bourdieu (1977) describes as doxa: the unquestioned, habitual enactment of dominant social norms.

2.5 Implications for Critical Pedagogy and Programme Design

Addressing these hidden paradigms requires a move toward critical entrepreneurship pedagogy—a form of teaching that foregrounds reflexivity, acknowledges the normative foundations of curricula, and invites pluralistic understandings of entrepreneurial practice (Berglund & Verduijn, 2018). This entails creating space for both students and educators to interrogate the values embedded in entrepreneurship education, recognize alternative paradigms, and understand the implications of privileging one over another. Without this critical engagement, educators may inadvertently reinforce narrow, hegemonic models of entrepreneurship that do not reflect the complex, dynamic, and socially embedded nature of entrepreneurial life (Johannisson, 2011; Chell, 2007).

3. Methods

To study expressions of the paradigms of entrepreneurship we use document analysis using the WURI Ranking 2024 of Global Top 300 Innovative Universities. In particular, we searched for Master of entrepreneurship programmes at the listed universities on this list in the US, Europe and Asia. While we could have analysed the top 30 universities on the selected ranking, this would have been largely dominated by US universities. As we assume that the national and regional culture of the universities matter, we chose to make sure that we had some variation on this dimension. As such, while the US is known for its individualistic nature and Asian countries more collectivistic (Hofstede, 2001), we rather aim to include the top 10 US, 10 Asian and 10 European, to maximize variation on the individualistic-collectivistic dimension.

3.1 Data Collection

For each of the universities we chose their most developed educational programmes solely dedicated to entrepreneurship at the master level (Table 1). We review and analyse the description and the choice of learning outcomes and pedagogy. We only include programmes where descriptions are available online. For each programme a description was developed to capture the orientation of the programme. The identification of each programme was done by Googling in an In Private window the university name and “master of entrepreneurship program”. The top listed non sponsored programme was picked from each university. The focus was on Master of Science or MBA programmes. To the degree that programmes including additional specifications such as “Master in Sustainable entrepreneurship” was the main result, this course was selected. We only studied the content of the required courses and did not take into consideration electives unless there were electives that were highly focused on the collective notion of entrepreneurship. In terms of courses, we

focused on the main entrepreneurship course in each of the programmes and looked for the degree to which the programmes included courses that focused on either of the two logics.

Table 1: Overview of programmes included

Nr	WURI Rank 2024	University	Location	Progamme
1	1	Minerva University	USA	No dedicated programme located
2	2	Arizona State University	USA	MSc
3	3	MIT	USA	MBA
4	4	University of Pennsylvania	USA	MSc
5	4	University of Pennsylvania	USA	BS
6	5	Stanford University	USA	No dedicated programme located
7	6	Ecole 42	Europe - France	No dedicated programme located
8	7	Aalto University	Europe - Finland	MSc
9	8	Hanze University of Applied Sciences	Europe - Netherland	No dedicated programme located
10	9	University of California, Berkeley	USA	MBA
11	10	California Institute of Technology (Caltech)	USA	No dedicated programme located
12	11	Princeton University	USA	No degree; Only courses
13	12	Harvard University	USA	MBA
14	13	Incheon National University	Asia -South-Korea	No dedicated programme located
15	16	Seoul National University	Asia -South-Korea	No dedicated programme located
16	17	National University of Singapore	Asia - Singapore	MSc
17	18	Abdullah Gul University	Asia- Turkey (also considered Europe)	No dedicated programme located
18	19	Tsinghua University	Asia - China	Certificate Master
19	20	Deggendorf Institute of Technology	Europe - Germany	MBA
20	21	University of Oxford	Europe - UK	No dedicated programme located
21	22	University of Cambridge	Europe - UK	MSc
22	27	Hankuk University of Foreign Studies	Asia - South-Korea	No dedicated programme located
23	29	Franklin University Switzerland	Europe -Switzerland	No dedicated programme located
24	33	Peking University	Asia - China	Organize around research centre
25	34	University of Twente	Europe - Netherlands	MSc
26	37	University College London	Europe - UK	MSc
27	40	Beijing Normal University	Asia - China	No dedicated programme located
28	42	Tra Vinh University	Asia - Vietnam	No dedicated programme located
29	43	Indira Gandhi Delhi Technical University for Women [IGDTUW]	Asia - India	No dedicated programme located
30	49	Kyoto University	Asia - Japan	No dedicated programme located

3.2 Analysis

We applied a framework where we looked for the traits in programme descriptions within the following areas: The general descriptions, the pedagogy, the learning outcomes and the course portfolio. The analysis was primarily done by the second and last author with the first authors scrutinizing the analytical process and content. The two coders checked each other's process and conclusions to ensure validity of the work. To ensure the validity of the research, we have described our research approach in depth above. As we use openly

accessible data, the study can be easily replicated. Also, the categorization of keywords identified are listen in the findings table. In terms of transferability, the analysis was done with a global scope using data from a broad set of different cultures. This was done to increase the usability of the results across contexts.

4. Findings

Both paradigms were found in the studied programmes. While the individualistic competitive paradigm was the dominant one, the collectivist paradigm was also present in some of the identified university programmes. As a first insight we identified a core set of subsidiary concepts that could be linked to the different paradigms, as illustrated in Table 2. The findings relative to each of the paradigms of entrepreneurship is described more in detail below.

Table 2: Overview of relevant words used to tag the different paradigms.

Paradigm of Entrepreneurship	Individualistic - Competitive	Collectivistic - Collaborative
Orientation	Profitable and competitive ventures	Social and sustainable entrepreneurship
Description – selected words	Venture creation, You, the firm, team, design thinking, ideation, best practices, competition, practical	Holistic approach to entrepreneurship, ecosystem, systemic, critical, entrepreneurial mindset, soft entrepreneurial skills, community
Pedagogy	Lectures, reports, class participation, presentations. theory and practice	Group work, reflection, process
Course portfolio that sets distinct focus	Economics, negotiations, traditional marketing, budgeting	Social Innovation; Sustainable Development Goals as Business Opportunities; Product Sustainability

4.1 The Logics of the Individualistic – Competitive

Most of the top ranked universities followed the logic of the individualistic competitive paradigm, especially for the US, but also for Asian universities. The descriptions of learning outcomes are functional – focusing on learning skills that enable entrepreneurship, with limited critical perspective or orientation. An example of this The University of Cambridge where the learning objectives are to "Learn to identify ideas for entrepreneurial ventures and how to evaluate their potential for success. Turn your ideas into a set of hypotheses and use tried-and-tested techniques to test your assumptions. Delve deep into the science of persuasion and identify the rational, social and emotional levers you can use to gain the support of critical audiences, like innovators, early adopters, co-innovators and distribution partners." (University of Cambridge). Thus, the main orientations of these programmes are towards the entrepreneur and the economic outcomes of business models.

While some of the individualistic programmes point to social entrepreneurship, the words related to a more collectivist paradigm in these programmes appear to be used as a signally mechanism to students that they 'care' about social issues, rather than really utilising a collectivist logic. This is evident in the lack of collectivist pedagogy and critical reflection in these programmes. In some of the programmes even social entrepreneurship is focussed on generating profits: "The basic thesis is that many social problems, if looked at through an entrepreneurial lens, create opportunity for someone to launch a venture that generates profits by alleviating that social problem." (University of Pennsylvania).

To the degree that the competitively oriented programmes market themselves in a more collectivist tradition they do so by pointing to the relevance of innovation ecosystems and resources on and off campus. An example is the MBA programme in entrepreneurship at MIT Sloan School of Management: "MIT Entrepreneurial Ecosystem: Introduces you to the broader MIT ecosystem and provides an overview of the abundant opportunities to collaborate across campus and gain help with your own ventures." Still, the main objective in utilizing the ecosystem is to maximize economic outcomes of individually based ventures. Limited emphasis is placed on development and value creation in teams. Across the individualistic programmes, an ecosystem orientation seems to be the first step towards increasing the degree to which a programme takes a more holistic approach to the teaching and practice of entrepreneurship.

4.2 Moving Towards the Logic of the Collectivist – Collaborative

There were limited cues of a collectivist mindset in the studied programmes. Only a very small handful of universities were offering programmes that seemed to aim to balance the paradigms and really consider a more critical and reflective stance, for example the MSc programme in entrepreneurship at Aalto University: "Students, through individual and team-based activities, will explore both, the "bright" and "dark" sides to entrepreneurship, while carefully reflecting and building upon their own views and understanding towards entrepreneurship." Thus, rather than aiming to build winners they take a more critical perspective to allow the more difficult dimensions of entrepreneurship to be visible and explicit.

We also find collectivistic and collaborative descriptions in the MSc programmes of Entrepreneurship at Twente University where they state that: "After completing this Master's specialisation, you: use your knowledge and skills to help businesses impact society positively; integrate innovation and entrepreneurship with sustainability; manage (international) business and innovation processes from a holistic, ethically responsible and accountable perspective." While Alto nuances the optimistic view of entrepreneurship, Twente takes a more holistic perspective and aims to broaden the students' perspective, which demands taking a more critical and ethical point of view.

At Harvard Business School the two categories seem merged, but the different courses have their own language and perspectives. In the mandatory case-based course "The Purpose of the Firm": "a short module designed to explore how, and under what circumstances, private firms can help address some of society's greatest challenges. Each of the five cases describes a set of leaders trying to "make a difference in the world" – that is, to harness the resources of the firm to tackle massive problems such as climate change, poverty, or economic development." This can be read as more collectivistic, while other mandatory courses like the Strategy course in the same programme where particular attention is paid to competitive positioning.

University College London seems focused on a collaborative and collectivistic approaches: "most of the teaching is collaborative, experiential and driven by 'build measure learn' cycles where students act, analyse, and reflect on the effects caused by that action, and decide on the next action to take. Themes of sustainable capitalism are embedded into several of the modules of the programme, reflecting their desire to create for-profit businesses that can also benefit our wider society and respect the environment. (University College London).

While there are traces of collectivist collaborative paradigm, the traces that we find are scarce and scattered. Most programmes that integrate collaborative cues primarily pose them as subsidiary to the overarching theme of the competitive nature and individualistic orientation of the entrepreneurial mindsets.

5. Discussion

While past entrepreneurship theory has called for the need to consider a more collective orientation in entrepreneurship education (Johannisson, 2011; Chell, 2007), our findings across leading innovative universities globally suggest that the individualistic–competitive paradigm remains dominant. Although some programmes incorporate aspects of collaborative or collectivist approaches, these are often framed as secondary or supplemental, rather than as core logics driving programme design. This indicates that in practice, rather than a clash of paradigms, we may be witnessing the ascendancy of a single dominant logic.

This raises concerns given current calls for entrepreneurial education to support sustainability, inclusivity, and critical reflection—skills broadly recognised as essential for future-ready graduates (Bennett, Dunne, & Carré, 2000; OECD, 2018). If entrepreneurship education remains oriented toward competitive, individual-centred success measured through narrow economic outcomes, it risks neglecting the development of broader entrepreneurial capabilities necessary for addressing complex societal and environmental challenges (Shepherd & Patzelt, 2011; Johannisson, 2011).

Our findings also complicate assumptions that cultural context directly determines paradigmatic orientation. Although Hofstede's (2001) seminal work on cultural dimensions posits that Asian cultures are generally more collectivist and Western cultures more individualist, our analysis reveals that Asian institutions often replicate the same individualistic paradigms seen in the US and parts of Europe. This may suggest the influence of global institutional isomorphism (DiMaggio & Powell, 1983), where universities conform to dominant models to maintain legitimacy in the eyes of international stakeholders. Such convergence could stem from a desire to climb international university rankings, which tend to prioritise entrepreneurial outcomes aligned with growth,

scalability, and innovation—metrics closely associated with the individualistic logic (Hazelkorn, 2015; Altbach, 2004).

The apparent mimicry of US pedagogical models—particularly among top Asian institutions—raises questions about cultural contagion and the uncritical adoption of dominant educational frameworks. Altbach (2004) argues, globalisation of higher education often leads to the imposition of Western norms, particularly American ones, which may not fully align with indigenous cultural values or societal needs. Unintentionally exporting a culturally specific definition of entrepreneurial success that undervalues collaborative, community-oriented, or mission-driven forms of entrepreneurship more commonly aligned with collectivist traditions (Hayton, George, & Zahra, 2002).

While a handful of programmes (e.g., Aalto, Twente, and UCL) demonstrate a more balanced or critically reflective orientation, these remain the exception rather than the rule. Moreover, within many programmes, collectivist elements are either isolated to specific modules or subsumed under broader individualistic goals. This fragmented incorporation of alternative logics can lead to internal contradictions within curricula, potentially confusing students and undermining the development of coherent entrepreneurial identities (Blenker et al., 2012; Rideout & Gray, 2013). For educators and academic programme developers it might be useful to emphasis holistic, ethically responsible and accountable perspectives using the SDGs actively throughout programmes rather than in individual goals when designing or redesigning education, to make sure the same logic is applied.

Ultimately, our findings highlight the need for more critical engagement with the pedagogical paradigms that underlie entrepreneurship education. When educators are unaware of the paradigms they are reproducing, they risk perpetuating narrow, exclusionary conceptions of entrepreneurship and overlooking the pedagogical potential of more inclusive, community-oriented, and reflective approaches. We encourage entrepreneurship educators to reflect on their own assumptions and consider how their teaching can support the development of entrepreneurs who are economically effective and also socially and environmentally responsive.

6. Conclusion

We provide a framework scholars can use in the review or design of entrepreneurship programmes that can address the underlying assumptions and values that entrepreneurship programmes are based on. In reviewing their own programmes, they can more explicitly consider whether the hidden paradigms reflect their own values and world views.

It would be interesting to revisit the data in five years' time to see if we would find more or less of the two extremes of this orientation scale or will there be a trend of moving towards one or the other? Also: Will we see a change in the positions of the orientations on the rankings over time?

In summary it seems the individualistic paradigm is the current 'winner' in terms of valued logics exhibited by top ranking Universities. Our aim for this paper was to highlight what might be hidden for many, and to open a discussion around what are the commonly shared paradigms underpinning entrepreneurship and are they being taught coherently in study programmes at the university level.

Ethics and AI Declaration

Ethical clearance for this research was not required; hence a clearance statement is not included. AI (GPT-4) was used selectively to support theory development, improve academic phrasing, and identify relevant literature. References suggested through the tool were independently verified for accuracy and peer-reviewed status. The AI was used as a supplementary aid, the authors maintaining full responsibility for all analytical interpretations, literature selections, and final composition decisions.

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Tools for Impact Measurement of University and Scientific Institution on Innovation Development

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Abstract: Nowadays innovations are very important for entrepreneurship and economic development. In turn, academic staff and students employed in universities and scientific institutions create the knowledge needed to develop innovation. Traditionally, new knowledge generated by universities and scientific institutions is offered to the general public in the form of scientific articles, monographs or patents. It is therefore important to clarify the efficiency of the involvement of academic staff and students in the production of scientific articles, monographs and patents. The above efficiency indicators can serve as tools for measuring the impact of universities and scientific institutions on innovation development. The object of the research is the formation of peer reviewed scientific articles not included in international databases WoS or SCOPUS at universities and scientific institutions in various scientific sectors. The subject of the research is the comparative analysis of the efficiency of formation of peer reviewed scientific articles not included in WoS and SCOPUS at universities and scientific institutions in various scientific sectors of Latvia. The objective of the research is the analysis of tools for impact measurement of universities and scientific institutions in various scientific sectors of Latvia on innovation development in the period from 2013 to 2018. The following tasks were determined to reach the objective: to study the formation of peer reviewed scientific articles not included in WoS or SCOPUS at universities and scientific institutions in various scientific sectors of Latvia; to identify the concept of the efficiency of peer reviewed scientific articles not included in WoS or SCOPUS formation in various scientific sectors; to carry out the tools for impact measurement of universities and scientific institutions on innovation development in various scientific sectors in Latvia. Research methods used in the paper are content analysis, economic analysis, and economic experiment.

Keywords: Scientific Articles, Efficiency Indicators, Comparative Analysis, Universities, Scientific Institutions, Latvia

1. Introduction

Every six years, the Ministry of Education and Science of the Republic of Latvia (IZM) shall organise an international evaluation of the scientific institutions (SIs) registered in Latvia (IESI). The last IESI took place in the period from 2013 to 2018. In order to establish the dynamics of the efficiency indicators of the academic staff involved in the formation of peer reviewed scientific articles not included in international databases "Web of Science" (WoS) or SCOPUS (RS) at the SIs of Latvia (IZM, 2021), the authors used the output data of findings across the set of SIs evaluations per period from 2013 to 2018 offered by "Technopolis-group" (TG). It provides an opportunity for the authors to calculate the RS indicators at the SIs of Latvia and to compare their dynamics during the period from 2013 to 2018. The research is limited by the fact that newer data required for the study is not currently available.

Data of the comparative analysis will help to develop support and motivation programs to increase the efficiency of involvement of the academic staff in the RS formation. In addition, the comparative analysis will reveal whether the score on quality of research at the SIs of Latvia in the IESI of TG coincides with the place of the SI of Latvia in the ratings of the RS indicators, and whether the quality of research score of the SI of Latvia also reflects the efficiency of the involvement of the academic staff of the SI of Latvia in the RS formation.

Hypothesis: The quality of research scores of the SIs shows the efficiency of the RS formation in the SIs of Latvia.

2. Theoretical Background

In the past decade a significant part of scientific literature has addressed the socio-economic impacts of university-industry research and development collaboration (Lima et al., 2021).

The authors rely on research of understanding, adapting, applying intellectual capital (IC) in universities (Mercado-Salgado et al, 2016), and research of the role of human capital in educational-training process at the university (Contu, 2017) presented different aspects of IC. Spica et al (2017a) state that IC is an economic category, the spiritual value created by the human potential, and it can be accumulated and converted into the

value of other capitals. By investigating certain information about the management of education, we can increase the capacity and significance of the country's total economic capital movement.

Scientific articles, monographs, and national and international patents form the totality of the IC of each SI. From this set of IC, peer reviewed scientific articles not included in international databases WoS or SCOPUS are conventionally considered IC. Such scientific publications provide an opportunity to determine the national competitiveness of various scientists, SIs, and sectors of science in Latvia.

Spica et al (2017a; 2017b) have worked out four indicators of the efficiency of the formation of IC in the higher education establishment: (1)The efficiency of the involvement of academic staff in the formation of IC per year in percentages (AIK); (2)The efficiency of the involvement of academic staff with a Doctorate degree in the formation of IC per year in percentages (DIK); (3)The efficiency of the involvement of students in the formation of IC per year in percentages (SIK); (4)Mutual efficiency of the involvement members of the academic staff with Doctorate degrees and the academic staff without Doctorate degrees in the formation of IC per year in times, (DE).

In order to calculate the AIK, DIK, SIK, and DE of the HEE Spica et al (2017a; 2017b) have worked out four formulas: (1) AIK = (ZPS : AS) x 100; (2) DIK = (ZPS : DS) x 100; (3) SIK = (ZPS : SS) x 100; (4) DE = DIK : AIK. Where: ZPS represents the number of scientific publications of the HEE per year; AS represents the number of academic staff in full-time jobs per year; DS represents the number of academic staff with Doctorate degrees holding in full-time jobs per year; SS represents the number of students per year.

3. Methodology

In their study, the authors will conduct a comparative analysis of SIs involved in the formation of RS in various sectors of science in Latvia. It comprised evaluation of SIs of six sectors of science: 1)Engineering and Computer Sciences (E&CS); 2)Natural Sciences (NS); 3)Medical and Health Sciences (M&HS); 4)Agriculture, Forestry, and Veterinary Sci-ences (A&F&VS); 5)Social Sciences (SS); 6)Humanities and Art Sciences (H&AS).

The authors modified the above mentioned formulas for the purposes of the study. Namely, calculate RS efficiency indicators for total numbers of full time equivalent (FTE) academic and research personnel (KIK), for FTE academic personnel (AIK), for FTE academic research personnel (PIK) and for PhDs completed at the SI (SIK). In addition, all the authors of the above-mentioned RS efficiency indicators were calculated for total number of self-reported outputs of articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS (RS). The authors calculated mutual efficiency indicators (PE) regarding involvement of the FTE academic research personnel (PS) and the FTE academic personnel (AS) in the formation of RS in times.

In the present research, the authors used the following data from the IESI: output data on the number of FTE academic personnel (AS), the number of FTE academic and research personnel (PS), the total number of FTE academic and research personnel (KS), the number of PhDs completed (SS), the number of articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS (RS) in period 2013-2018 per SI in Latvia. Authors revised the above RS for the year. TG analysed 62 SI of Latvia.

In this study, one RS are accepted as one unit of IC. Further, using the modified formulas 1; 2; 3; and 4, were calculated: KIK, AIK, PIK, SIK, PE. Then, according to the results obtained through the author's calculations, a corresponding rating place was assigned to each SI of Latvia per year and each of the above indicators KIK, AIK, PIK and SIK.

Each rating location was then assessed with an appropriate score, where the lowest score is 1 point, while the highest score is 5 points. The above mentioned assessment system makes it possible to compare the quantitative efficiency indicators of SI of various scientific sectors in Latvia calculated by the authors with IESI overall assessment criterion - quality of the research performance of the SI. The relevant Panel of the TG was a score of the research performance of each SI using the scale, where score 5 means outstanding level of research, score 4 means very good level of research, score 3 means good level of research, score 2 means adequate level of research, score 1 means poor level of research (IZM, 2021).

Next, the unified overview of all six sectors of science in Latvia was created. Here, the SIs were arranged according to the obtained rank in their sector of science. Furthermore, indicators of the efficiency of the involvement of academic staff of each SI in the formation of RS were added. The authors then selected one SI with the highest efficiency indicator of the involvement of academic staff in the formation of RS from the unified

review of the sectors of science in Latvia, accepted it as the basic indicator, and equated it to 100%. Further, the authors calculated the proportion of the efficiency of the involvement of academic staff of each SI in the base indicator.

After that, a rating scale of the results obtained was created on five-score system, where the highest rating is five score, and the lowest rating is one score. The new efficiency rating system for the involvement of academic staff of SIs in the formation of RS created by authors provides for granting of one score for the obtained efficiency indicators from 1% to 20%, 2 scores - for the obtained efficiency indicators from 21% to 40%, 3 scores - for the obtained efficiency indicators from 41% to 60%, 4 scores - for the obtained efficiency indicators from 61% to 80%, and 5 scores - for the obtained efficiency indicators from 81% to 100%,

The follow-up authors compared the results of their own estimates of SI quantitative indicators to the relevant Panel of the TG's results of qualitative indicators, calculated the difference between the indicators and the changes. For this purpose, the authors calculated for each SI score of indicators recording efficiency of RS and average score of each scientific sector. After that, authors compared these scores with scores of quality of the research of each SI developed by Panel of the TG.

4. Results

To calculate the efficiency of the involvement of academic staff in the formation of RS the authors used formulas that were developed and approbated already before and now modified.

AIK = (RS : AS) x 100 (1)

PIK = (RS: PS) x 100 (2)

KIK = (RS : KS) x 100 (3)

SIK = (RS: SS) x 100 (4)

PE = PIK : AIK (5)

Table 1: Performance indicators of the involvement of academic personnel of SIs in the formation of RS in a year and their comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

AIK rating	E&CS AIK (%)	E&CS AIK (%) of base indicator	E&CS AIK score	NS AIK (%)	NS AIK (%) of base indicator	NS AIK score	M&HS AIK (%)	M&HS AIK (%) of base indicator	M&HS AIK score	A&F&VS AIK (%)	A&F&VS AIK (%) of base in-dicator	A&F&VS AIK score	SS AIK(%)	SS AIK (%) of base indicator	SS AIKscore	H&AS AIK (%)	H&AS AIK (%) of base indicator	H&AS AIK score
1	829	100	5	116	14	1	165	20	1	200	24	2	468	56	3	527	64	4
2	547	66	4	97	12	1	99	12	1	0	0	0	233	28	2	309	37	2
3	393	47	3	82	10	1	40	5	1	0	0	0	228	28	2	201	24	2
4	267	32	2	68	8	1	39	5	1	0	0	0	212	26	2	186	22	2
5	248	30	2	0	0	0	0	0	0	0	0	0	182	22	2	143	17	1
6	219	26	2	0	0	0	0	0	0				161	19	1	57	7	1
7	174	21	2	0	0	0	0	0	0				137	17	1	55	7	1
8	159	19	1				0	0	0				118	14	1	20	2	1
9	150	18	1										117	14	1	4	0	0
10	95	11	1										100	12	1	0	0	0
11	71	9	1										82	10	1	0	0	0
12	16	2	1										69	8	1			
13	0	0	0										0	0	0			

AIK rating	E&CS AIK (%)	E&CS AIK (%) of base indicator	E&CS AIK score	NS AIK (%)	NS AIK (%) of base indicator	NS AIK score	M&HS AIK (%)	M&HS AIK (%) of base indicator	M&HS AIK score	A&F&VS AIK (%)	A&F&VS AIK (%) of base in-dicator	A&F&VS AIK score	SS AIK(%)	SS AIK (%) of base indicator	SS AIKscore	H&AS AIK (%)	H&AS AIK (%) of base indicator	H&AS AIK score
14	0	0	0										0	0	0			
15	0	0	0										0	0	0			
16	0	0	0															
Average	207	25	2	145	17	1	164	20	1	283	34	2	144	17	1	98	12	1

According to Table 1 the highest AIK indicator in the formation of RS in a year is 829% and was accepted by the authors as the basic indicator or 100%. The above indicator has been achieved by a SI representing the E&CS. Consequently, the efficiency indicator of the SIs of other sectors of science in Latvia were attributed to this higher efficiency indicator in order to determine their proportion as a percentage. Then, according to the new rating system developed by the authors, each SI was assigned a certain number of scores.

Table 2: Performance indicators of the involvement of academic research personnel of SIs in the formation of RS in a year and their comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

PIK rating	E&CS PIK (%)	E&CS PIK (%) of base indicator	E&CS PIK score	NS PIK (%)	NS PIK (%) of base indicator	NS PIK score	M&HS PIK (%)	M&HS PIK (%) of base indicator	M&HS PIK score	A&F&VS PIK (%)	A&F&VS PIK (%) of base indicator	A&F&VS PIK score	SS PIK (%)	SS PIK (%) of base indicator	SS PIK score	H&AS PIK (%)	H&AS PIK (%) of base indicator	H&AS PIK score
1	416	5	1	43	1	1	7992	100	5	354	4	1	900	11	1	1615	20	1
2	317	4	1	41	1	1	469	6	1	40	1	1	675	8	1	1228	15	1
3	265	3	1	34	0	0	150	2	1	27	0	0	596	7	1	647	8	1
4	187	2	1	20	0	0	98	1	1	12	0	0	438	5	1	567	7	1
5	166	2	1	12	0	0	90	1	1	5	0	0	404	5	1	382	5	1
6	148	2	1	12	0	0	35	0	0				401	5	1	198	2	1
7	106	1	1	1	0	0	3	0	0				272	3	1	165	2	1
8	101	1	1				3	0	0				248	3	1	148	2	1
9	99	1	1										208	3	1	96	1	1
10	90	1	1										175	2	1	90	1	1
11	88	1	1										124	2	1	52	1	1
12	70	1	1										122	2	1			
13	58	1	1										71	1	1			
14	38	0	0										39	0	0			
15	16	0	0										0	0	0			
16	0	0	0															
Average	128	2	1	21	0	0	58	1	1	57	1	1	256	3	1	170	2	1

Comparing the figures collected in Table 2, the authors conclude that the highest PIK indicator of 7992% is for the SI of the M&HS, while the lowest PIK indicator of 1% is for the SI of the NS. It follows that only one SI get the highest rating of 5 score, fourteen SIs get 0 score, but other forty five SIs get 1 scores.

Table 3: Performance indicators of the involvement of PhDs completed at SIs in the formation of RS in a year and their comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

SIK rating	E&CS SIK (%)	E&CS SIK (%) of base indicator	E&CS SIK score	NS SIK (%)	NS SIK (%) of base indicator	NS SIK score	M&HS SIK (%)	M&HS SIK (%) of base indicator	M&HS SIK score	A&F&VS SIK (%)	A&F&VS SIK (%) of base indicator	A&F&VS SIK score	SS SIK (%)	SS SIK (%) of base indicator	SS SIK score	H&AS SIK (%)	H&AS SIK (%) of base indicator	H&AS SIK score
1	450	27	2	165	10	1	195	12	1	311	18	1	814	48	3	1683	100	5
2	392	23	2	135	8	1	182	11	1	248	15	1	767	46	3	1167	69	4
3	283	17	1	128	8	1	138	8	1	119	7	1	600	36	2	779	46	3
4	248	15	1	109	6	1	66	4	1	108	6	1	325	19	1	531	32	2
5	198	12	1	57	3	1	50	3	1	20	1	1	260	15	1	451	27	2
6	180	11	1	32	2	1	24	1	1				257	15	1	140	8	1
7	172	10	1	11	1	1	14	1	1				225	13	1	138	8	1
8	154	9	1				12	1	1				178	11	1	121	7	1
9	138	8	1										150	9	1	110	7	1
10	128	8	1										123	7	1	31	2	1
11	104	6	1										58	3	1	0	0	0
12	100	6	1										56	3	1			
13	87	5	1										24	1	1			
14	65	4	1										0	0	0			
15	55	3	1										0	0	0			
16	0	0	0															
Average	156	9	1	48	3	1	75	4	1	187	11	1	112	7	1	222	13	1

In Table 3, according to the SIK indicators the first place and highest score 5 is taken by the SI of the H&AS, while the lowest SIK indicator of 11% is for the SI of the NS. Only one SI gets the 4 score, three SIs get the 3 score, two SIs get 2 score, but other SIs get 1 score.

Table 4: Performance indicators of the involvement of total academic staff of SIs in the formation of RS in a year and their comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

KIK rating	E&CS KIK (%)	E&CS KIK (%) of base indicator	E&CS KIK score	NS KIK (%)	NS KIK (%) of base indicator	NS KIK score	M&HS KIK (%)	M&HS KIK (%) of base indicator	M&HS KIK score	A&F&VS KIK (%)	A&F&VS KIK (%) of base indicator	A&F&VS KIK score	SS KIK (%)	SS KIK (%) of base indicator	SS KIK score	H&AS KIK (%)	H&AS KIK (%) of base indicator	H&AS KIK score
1	277	3	1	43	1	1	7992	100	5	128	2	1	217	3	1	273	3	1
2	130	2	1	30	0	0	469	6	1	40	1	1	175	2	1	259	3	1
3	105	1	1	24	0	0	61	1	1	27	0	0	161	2	1	198	2	1
4	100	1	1	17	0	0	47	1	1	12	0	0	147	2	1	162	2	1
5	99	1	1	12	0	0	31	0	0	5	0	0	129	2	1	117	1	1
6	86	1	1	10	0	0	19	0	0				111	1	1	96	1	1
7	77	1	1	1	0	0	3	0	0				105	1	1	62	1	1
8	76	1	1				3	0	0				101	1	1	49	1	1
9	73	1	1										80	1	1	40	1	1
10	51	1	1										67	1	1	18	0	0
11	42	1	1										54	1	1	4	0	0
12	40	1	1										49	1	1			
13	38	0	0										44	1	1			
14	16	0	0										39	0	0			
15	14	0	0										0	0	0			
16	0	0	0															
Average	79	1	1	19	0	0	43	1	1	47	1	1	92	1	1	62	1	1

According to Table 4, the highest KIK indicator is 7992% and representing the SI of the M&HS. In the six scientific sectors forty SIs get 1 score, but the other twenty one SIs get 0 score. It follows that total academic staff of SIs in various sectors of science in Latvia in period from 2013 to 2028 did not competitive in the formation of RS on national scientific environment.

Table 5: Performance indicators of the mutual efficiency indicators regarding involvement of total academic research personnel and total academic personnel of SIs in the formation of RS in times a year, quality of research (QTG) scores by TG, new total quantity KIK scores of SIs, and their comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

KIK rating	E&CS PE	E&CS QTG score	E&CS KIK score	NS PE	NS QTG score	NS KIK score	M&HS PE	M&HS QTG score	M&HS KIK score	A&F&VS PE	A&F&VS QTG score	A&F&VS KIK score	SS PE	SS QTG score	SS KIK score	H&AS PE	H&AS QTG score	H&AS KIK score
1	0,5	3	1	0	4	1	0	2	5	1,8	3	1	0,9	3	1	1,1	2	1
2	1,5	3	1	0,4	3	0	0	3	1	0	2	1	0	4	1	5,2	3	1
3	1,5	2	1	0,4	2	0	0,6	4	1	0	3	0	3,2	2	1	0	4	1

KIK rating	E&CS PE	E&CS QTG score	E&CS KIK score	NS PE	NS QTG score	NS KIK score	M&HS PE	M&HS QTG score	M&HS KIK score	A&F&VS PE	A&F&VS QTG score	A&F&VS KIK score	SS PE	SS QTG score	SS KIK score	H&AS PE	H&AS QTG score	H&AS KIK score
4	0,7	3	1	0,2	4	0	0,9	4	1	0	4	0	1,7	3	1	6,6	4	1
5	0	2	1	0	4	0	3,8	1	0	0	4	0	2,4	3	1	4,5	2	1
6	0,2	2	1	0,2	3	0	0,9	3	0				4,4	3	1	0	4	1
7	0,9	2	1	0	3	0	0	5	0				7,6	2	1	0,5	3	1
8	0,4	3	1				0	4	0				1,7	2	1	6,8	3	1
9	0,2	3	1										2,1	2	1	2,7	3	1
10	2,6	2	1										2,1	3	1	8,4	4	0
11	0,4	3	1										0,3	3	1	11,6	4	0
12	0,7	2	1										1,5	1	1			
13	0	3	0										1,8	2	1			
14	0	4	0										0	1	0			
15	5,5	1	0										0	1	0			
16	0	1	0															
Average	0,6	-	1	0,2	-	0	0,4	-	1	0,2	-	1	1,8	-	1	1,7	-	1

In Table 5, the PE indicators rests in the range from 0,2 to 11,6 in respect of the SIs in Latvia. The highest PE is held by the SI in the H&AS, while the lowest PE belongs to two SI's in the E&CS, and, to two SI's in the NS.

The highest average rate of the PE indicators is 1,8 in the SS, the second highest average rate of the PE indicators is 1,7 in the H&AS. It follows that academic research personnel of the SIs of the SS and the H&AS is more effective as their academic personnel in the formation of RS. Lowest average rate of the PE indicators is 0,2 in the NS, and the A&F&VS. It follows that academic personnel of above scientific sectors is a bit effective in the formation of RS to compare with academic research personnel at the SIs of the NS, and the A&F&VS.

When comparing QTG scores by TG to new total quantity KIK scores calculated by authors, it can be concluded that they differ from 1 score to 5 scores in total. The assessment of the QTG scores and new KIK scores of each SI in various sector of sciences in Latvia results in a conclusion that new KIK scores were too lower, and, except for the one SI in the M&HS, where KIK score highest, and, one SI in the SS, where QTG, KIK scores coincided.

Table 6: The summary of performance indicators of the involvement of total academic staff of SIs in the formation of RS in a year and their total margins of AIK, PIK, SIK, and KIK indicators comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

Scores	Total margins of AIK (%)	Total margins of PIK (%)	Total margins of SIK (%)	Total margins of KIK (%)	Total average margins of AIK (%)	Total average margins of PIK (%)	Total average margins of SIK (%)	Total average margins of KIK (%)
0	4 - 4	1 - 39	-	1 - 39	-	21 - 21	-	19 - 19
1	16 - 165	40 - 1615	11 - 325	40 - 469	98 - 164	57 - 256	48 - 222	43 - 92
2	174 - 309	-	392 - 600	-	207 - 283	-	-	-
3	393 - 468	-	767 - 814	-	-	-	-	-
4	527 - 547	-	1167 - 1167	-	-	-	-	-
5	829 - 829	7992 - 7992	1683 - 1683	7992 - 7992	-	-	-	-

From the results summarised in the tables 6, authors conclude that for all AIK, PIK, SIK, KIK indicators whose

score is 1, the total margins of PIK indicators and total average margins of PIK indicators are the highest. They are followed total margins of KIK indicators and total average margins of SIK indicators. Total margins for all indicators whose score is 5, belongs to AIK, PIK, SIK and KIK indicators. Total margins for all scores from 1 to 5, which find only for AIK indicators.

5. Conclusions

The study of the authors did not result in confirming hypothesis. The quality of research scores of the SIs do not shows the efficiency of the RS formation in the SIs of Latvia. When comparing the QTG scores of TG group to the new KIK scores by the authors, it can be concluded that they differ from 1 to 5 scores in total.

The study shows that new performance indicators KIK of the involvement of total academic staff of SIs in the formation of RS in various sectors of sciences in Latvia in period from 2013 to 2018 were lower as shown by the results compiled by the relevant Panel of the TG, except for the one SI of the M&HS, where the KIK score was highest per 3 scores, and, except for one SI in the SS, where QTG, KIK scores coincided

The authors are encouraged to supplement the methodology for international evaluation of scientific institutions with four efficiency indicators AIK, PIK, SIK, KIK of the involvement of academic staff and PhDs completed at the SIs in the formation of RS per year in percentage, and, PE in times, and performance indicators of their comparative analysis in various sectors of sciences in country.

The novelty of the research is that methodology allows comparison of the efficiency of the involvement of SIs in the formation of scientific articles in the country, determination for indicators of the AIK, PIK, SIK, KIK total limits, in conformity with them, clarification of the score evaluation system for IESI.

Ethical Declaration

The authors declares that there are no ethical issues related to the research presented in this paper.

AI Declaration

The authors declares that no significant AI tools or technologies were used in the conduct the research for this paper.

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Learner Satisfaction, Academic Performance, Micro-credential Design: A Case Study from European Universities

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Abstract: Recently, asynchronous distance learning has been gaining research attention at an accelerating pace, enabling digital transformation in education and helping learners acquire the necessary skills. Hence, micro-credentials have also raised significant scholarly interest. One of the main challenges in distance online learning is to keep the learners engaged throughout and satisfied with their learning journeys. This is especially true in micro-credentials, which, more often than not, come on top of regular studies and professional and social commitments of the learners. In general, a substantial body of research exists on student satisfaction with online distance learning and micro-credentials specifically. Researchers investigate the effectiveness of specific activities, create and compare varied course designs, and analyse factors affecting student satisfaction with online learning. However, the existing research is fragmented due to the different spectrums of learning activities analysed in different educational contexts. In addition, the research on innovative learning designs of micro-credentials is limited. To address these gaps, we present a case study of a micro-credential "AI for Business" which is proposed to students from 14 European universities collaborating under the European Consortium of Innovative Universities umbrella. The body of the micro-credential includes 51 learning activities, including hands-on small projects invoking artificial intelligence and process automation tools, discussions, interactive e-texts, memory cards, games with sound and motion, interactive videos, quizzes, peer assessment, experiential learning, challenge-based learning with challenges from real businesses – our social partners and, at the same time, leaders in their markets, and much more. Such a great variety of learning activities within the same micro-credential allows for comparing the learning activities by student satisfaction while ensuring equal environmental conditions and eliminating potential inaccuracies which otherwise could have arisen from different courses – that is, contexts – in which the activities are employed. In addition, we present the micro-credential design and explore whether the learner satisfaction rates correlate with the grades received. Therefore, this case study enriches the research on innovative learning designs for micro-credentials and learner satisfaction with online learning activities, both subjects which scholars have highlighted as needing deeper academic investigation.

Keywords: Asynchronous Distance Learning, Course Design, Innovative Study Methods, Micro-credential, Student Satisfaction

1. Introduction

Digital technology has changed the way we learn and teach. Flexible learning, self-directed learning, virtual learning, online learning, and similar key terms highlight the scale of this trend. The variety of digital resources and tools has also led to a change in the role of the learner from a passive receiver of information to an active, often self-directed learner. At the same time, new challenges arise, such as ensuring learner engagement (Lasekan et al. 2024, Moore et al. 2025), motivation to complete the course successfully (Stolk et al. 2021), balancing learning resources to address learner differences (Deng 2021), or how to align online tools with learning theories and learning environment (Kakouris, Sitaridis 2025).

Although there is a large body of research examining the relationship between learning resources and learner engagement or satisfaction, insufficient attention has been paid to the innovative learning designs of micro-credentials (Moore et al. 2025). With the scholarly support for active learning predominating (Barnett-Itzhaki et al. 2023), especially in distance learning (Lasekan et al. 2024), there is limited comparison between active and passive learning methods in distance learning versus online extracurricular learning. It is also necessary to consider the importance of learner profiles in assessing their engagement and motivation when taking an elective course compared to a required one (Deng 2021, Stolk et al. 2021). In addition, the research on authoring tools used to create the content for asynchronous online learning is scattered across diverse academic disciplines, geographic locations, and isolated educational techniques and authoring tools placed in these specific yet different conditions, making it challenging to develop a cohesive understanding of best practices in digital micro-credentials.

This case study aims to present a micro-credential as an instance of an asynchronous distance learning that gathers a broad variety of educational techniques and authoring tools within one course offered to learners from several universities. The cohesive and well-structured setting enables clear, objective comparisons of learner satisfaction with different educational methods and authoring tools, independent of most contextual influences.

2. Course Design

The micro-credential *AI for Business* is proposed to students of all cycles of the European Consortium of Innovative Universities (ECIU) network that unites 14 European universities. The course accounts for 2 European Credit Transfer and Accumulation System (ECTS) credits. While, in general, ECIU students have the options to either engage in an academic exchange for a semester, or attend short-term in-person gatherings, or participate remotely through online platforms, the *AI for Business* micro-credential is provided as an online asynchronous self-paced course with exact start and finish dates. Access to the learning materials on Moodle is granted from the start day of the micro-credential and withdrawn 1 week after the end day of the study period.

The course spans over 6 weeks: intro week, four subject-dedicated weeks, and outro week. However, the initial pilot course, offered during the autumn semester of the 2024/2025 academic year, encompassed the full six-week curriculum within a four-week timeframe, assuming the workload is around 13.5 hours per week. The consistent structure and design are preserved throughout the course as demonstrated in Figure 1.

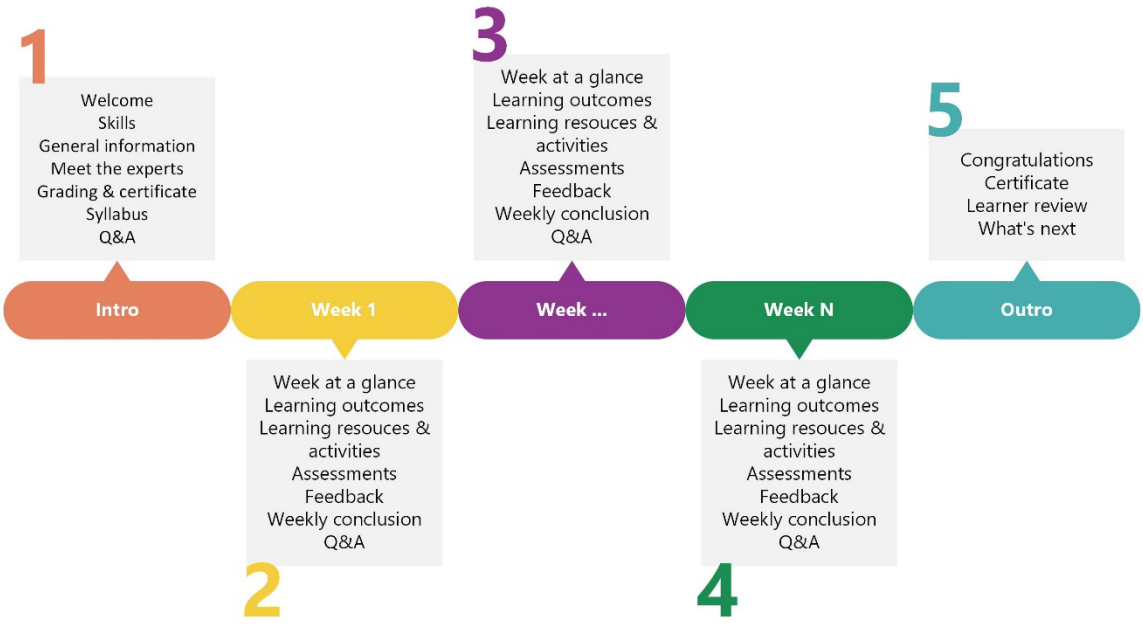


Figure 1: Micro-credential design

Every course topic begins with a flipbook reading – an immersive publication with audio, video, images, links to external sources and Moodle exercises – to engage the learners while acquiring topic-specific knowledge. The reading is followed by varied learning activities which are presented in more detail in the next section. Each subsequent activity opens when the previous activity with completion status is marked complete – either automatically, where possible, or by students manually. Each week, learners have access to multiple video lectures, typically consisting of two to five videos, each lasting 5-15 minutes. These videos elucidate the core theory and provide practical examples to illustrate real-world use cases and to support varied learning preferences. The videos are professionally recorded, featuring the teacher speaking, accompanied by background music, slides displayed, subtitles, and various visual effects. The total duration of the course videos is 120 minutes. Every topic is accomplished by a feedback survey where learners assess the activities and leave comments on a voluntary basis.

However, topics should not be confused with weeks, as weeks 1 to 3 include two topics each, while the last content week includes one topic, thus embracing seven subject topics in total. Moving up to the weekly structure, every week encompasses a hands-on project designed to enhance students' proficiency in the application of AI tools. These projects provide a valuable blend of theoretical understanding and real-world problem-solving skills. Further, through peer assessment, students engage in evaluating two hands-on projects submitted by peers, thus fostering dynamic and interactive learning. The collaborative learning environment is also enhanced by discussion forums which serve as platforms to exchange ideas and perspectives with fellow participants. Two discussion topics are suggested by real-life enterprises and arise from the challenges businesses face.

3. Course Contents

The learning activities and resources implemented in the micro-credential are crafted to facilitate the attainment of anticipated learning outcomes, enabling the acquisition of new knowledge and the development of expected skills and competencies. Several activities are developed and supported by such acknowledged institutions as the Massachusetts Institute of Technology, UK National Crime Agency (NCA), and Queen Mary University of London, with support from Google and the UK Engineering and Physical Sciences Research Council (EPCRC).

The teaching techniques applied in the micro-credential are summarised in Figure 2. The amount of time required to accomplish weekly activities was calculated using the course workload estimator by the British Columbia Institute of Technology, Learning & Teaching Centre (BCIT LTC n.d.). While the subject-dedicated weeks account for 52.5 hours, the rest is dedicated to the intro and outro weeks.



Figure 2: Teaching techniques by week

As mentioned in the abstract of this case study, the number of learning activities under the analysis reaches 51. However, because several learning activities include a few educational techniques, the number of educational techniques presented in Figure 2 exceeds 51. For instance, the Intelligent Piece of Paper activity, developed by Peter McOwan and Paul Curzon from Queen Mary University of London (Computer Science for Fun, N.d.), includes two parts in the micro-credential: first, the learners are asked to reflect on the activity's situations and questions in a written form (structure strip); and second, the learners are invited to play a game with a digital piece of paper which sequentially provides its pre-coded moves.

Another example of a learning activity involving several educational techniques is challenge-based learning, where learners are presented with real-world challenges provided by actual regionally and globally leading businesses. To present the solutions, students need to record a video presentation and submit it to the Moodle forum. In addition, the learners assess the presentations of at least two peers, provide ratings and comments, thus developing their collaborative and critical thinking skills.

The proposed educational techniques enhance both active (e.g., exercises, tests, games, presentations, etc.) and passive (e.g., reading, video watching) learning, with the active learning dominating in the course. A variety of authoring tools are used in the course: Moodle quizzes for tests, forums for discussions and presentations, database for registering field research results; Sharable Content Object Reference Model (SCORM) packages for video-based case studies; H5P (Hypertext Mark-up Language 5 (HTML5) Package) for exercises, including

structure strip, image slider, guess the answer, drag and drop, interactive video, sort the paragraphs, crossword, fill in the blanks, image sequencing, memory game; Open eLearning (SCORM) for gamification with audio, motion, and video. Figure 3 demonstrates the authoring tools used.

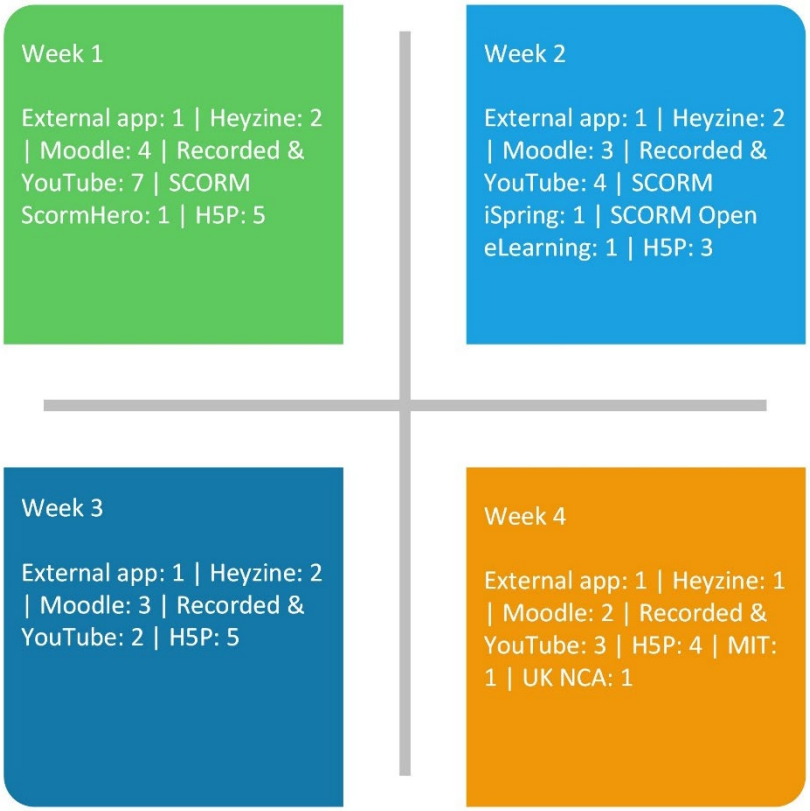


Figure 3: Authoring tools by week

In addition, external applications are used to offer learners hands-on opportunities to apply theoretical knowledge and gain practical experience in utilising AI tools. These hands-on projects are designed to enhance the learners' proficiency in applying AI tools, providing a valuable blend of theoretical understanding and problem-solving skills.

4. Learner Satisfaction

4.1 Methodology

The micro-credential was offered to 31 registered ECIU network learners from October 15th till November 12th, 2024. The learners' affiliations concern the following universities: Hamburg University of Technology (Germany), Lodz University of Technology (Poland), Universitat Autònoma de Barcelona (Spain), University of Twente (the Netherlands), Linkoping University (Sweden), Dublin City University (Ireland), University of Trento (Italy), and Kaunas University of Technology (Lithuania). At the end of each topic, the learners were asked to provide feedback about each topic's activity using a Likert scale ("Please rank your experience with …"). The answers were then encoded numerically as follows: 1 – very disliked, 2 - disliked, 3 – neutral, 4 – liked, 5 – very liked. Microsoft Excel's PivotTable and Analyse Data functionalities were utilised to conduct descriptive statistical analysis and get insights. For the correlation analysis, Visual Studio Code with Python programming language were employed. Statistical significance measures are disregarded due to the small sample size and the unique study context.

4.2 Learner Satisfaction Analysis Results

4.2.1 Active Versus Passive

Frequent research findings (Holbrey 2020, El Sadik & Al Abdulmonem 2021, Barnett-Itzhaki et al. 2023) confirm that active learning methods lead to higher levels of learner engagement and more effective assurance of

learning. However, the results of this study suggest that passive learning methods have almost the same average rating (3.67) as active ones (3.70), contradicting the idea that active learning is way more engaging and satisfying, especially in distance learning (Lasekan et al. 2024).

This finding could be explained by multimedia and animation embedded into the course readings, thus making them more interactive and engaging, or by good-quality and rich-content video recordings. It is important to note that a large part of previous studies investigate one or more active approaches, such as educational escape rooms, game-based learning, experiential learning, blogs or similar, in isolation. Thereby, the results of this study shed more light on learners' satisfaction with active learning from the comparative perspective. Another assumption for such a result is the fact that the micromodule under investigation is extracurricular, which has likely led to the learners being more motivated to acquire new knowledge passively. The results may also reflect the need to consider not just interactivity, but also discipline specificity, learning environment, and learning style and modes, as noted by Kakouris (2009) and Kakouris and Sitaridis (2025).

Passive learning was evaluated more consistently (SD = 0.88), though not necessarily more favourably. Active methods, in turn, have higher variability in learner satisfaction (SD = 98). While active learning is supposed to be more engaging, it is often also more demanding. This results in divided learner opinions depending on preparedness, support, preferences and other individual factors (Noesgaard & Ørngreen 2015, Ma & Lee 2021).

4.2.2 Top Learning Activities

The top 5 learning activities, based on their average ratings, are as follows: a concept-reinforcement crossword created with H5P within the topic AI-Powered Financial Management and Analysis (4.26); the moral machine (4.11) (the Max Planck Institute et al., n.d.) developed by scientists from the Massachusetts Institute of Technology (MIT), University of Exeter, the Max Planck Institute, Toulouse School of Economics, and the University of British Columbia (UBC); Moodle quizzes in the topics Enhancing HR and Workforce Management with AI (4.1) and AI-powered Financial Management and Analysis (4.05), each consisting of five closed questions of diverse types; fill in the blanks created with H5P – a video with a subsequent sentence aiming at solidifying the knowledge on linear versus matrix production systems (4.05). Hence, the top learning activities vary in terms of both the authoring tools used to digitize them and the educational techniques applied, thus making it impossible to make any conclusions on which educational techniques or authoring tools are most preferred by learners.

4.2.3 Learner Satisfaction by Educational Techniques

The analysis of activities grouped by educational techniques (Table 1) provides more meaningful insights into what kind of learning activities are more and less enjoyed by learners.

Table 1: Average learner satisfaction by educational techniques

	Average	SD	Description
Test	3.96	0.70	Closed tests, five questions of varied type each, digitized with Moodle quiz
Field research	3.86	0.71	Learners search for counts of combinations of AI with relevant theories (agile, lean, six sigma, etc.) in LinkedIn and register the findings in the Moodle database
Gamification	3.83	0.87	Intelligent Paper (described in chapter 3, digitized with H5P image slider), the Moral Machine (described in this chapter), CSC Cyber Games (NCA, n.d.), memory game created with H5P, level-up game developed with Open eLearning with motion, audio, and video
Case study	3.76	0.87	Process mining and Wall Street Journal (videos with SCORM packages for questions)
Discussion	3.69	1.08	Moodle forum: at least one post and two replies
Reading	3.68	0.69	Digital flipbooks created in Heyzine, featuring images with a jumping animation effect, videos, and links
Exercise	3.68	0.98	Varied short learning activities, mostly H5P as described in chapter 3
Video lecture	3.66	1.00	Recorded professional videos featuring the teacher, slides, animation
Project	3.42	1.31	Hands-on small projects invoking artificial intelligence and process automation tools (external)
Reflection	3.38	1.09	The first part of the intelligent paper activity, H5P structure strip

	Average	SD	Description
Presentation	3.18	1.12	Solutions to challenges proposed by actual enterprises; submitted to Moodle forum; peer assessment is involved

Activities rooted in structured or guided formats, such as tests, case studies, or gamified learning activities, perform best in terms of average satisfaction and consistency. This aligns well with the educational theory (Holbrey 2020, Poondej & Lerdpornkulrat 2020, Martinez et al. 2022, Khaldi et al. 2023, Lasekan et al. 2024).

Readings, while consistently rated, received more moderate evaluations, suggesting they were accepted, but not strongly favoured by the learners. The fact that videos, on average, score lower than readings is a fascinating insight and one that might seem counterintuitive given how much educational theory and practice emphasise video as an engaging study format (Lackmann et al. 2021, Seo et al. 2021, Liao & Wu 2023). A reason could be that the videos were mostly dedicated to difficult and niche aspects of the subject and could have been attention-fatiguing. Another clue behind the lower videos' rating is related to the non-traditional format of the readings, as the latter are enriched by multimedia. These results raise the possibility that interactive readings could be more positively received than video content by learners. The results confirm the need to analyse not only the format of the resources used, but also their features, such as visual clarity, the use of infographics (Lackman et al. 2021), quizzes embedded lecture videos (Kovacs 2016), or the visual presentation.

A digital discussion was also rated moderately positive. However, its high SD suggests an uneven learner experience. Although the scientific literature strongly supports the benefits of forums, discussion boards, chat sessions and blogs in e-learning and highlights the need for camaraderie feeling and avoiding the "nobody" perspective (Bender 2023), online discussions may appear among the least engaging activities. This points to the need to further investigate the impact of learner profiles and discussion characteristics on learner satisfaction. Similarly, the data show that learners generally appreciate exercises; however, their satisfaction varies, which could point to differences in quality or relevance across the activities.

The lowest-rated learning activities demand the highest levels of critical thinking, creativity, problem-solving skills, and effort. However, despite the benefits of applying real-world challenges, "bringing students closer to the real world" and thus increasing learners' motivation and engagement (Gaskins et al. 2015, Conde et al. 2017), these tasks often require learners to invest more time and navigate ambiguity (De Stefani & Han 2022), all of which can lead to discomfort or resistance, especially in self-paced or digital environments. As Ebbini (2023) states, „self-paced learning can be challenging for students who struggle with time management and procrastination" or prefer more structured or guided learning.

In addition, problem- and challenge-based learning has mixed reviews, possibly depending on how self-directed or supported learners felt. This suggests a potential gap between pedagogical intention and learner perception and highlights the need for greater scaffolding in implementing higher-order learning experiences. On the other hand, these activities are characterised by higher SDs, suggesting greater polarisation in learner satisfaction in comparison to less effort-requiring activities.

4.2.4 Learner Satisfaction by Content-authoring Tools

The average learner satisfaction by content-authoring tools is presented in Table 2.

Table 2: Average learner satisfaction by authoring tools

	Average	SD
Moral Machine	4.111111111	0.657342198
Cyber Games	4	0.816496581
Moodle	3.77722083	0.892863
SCORM	3.757142857	0.866913671
Open eLearning	3.75	0.766485486
Heyzine	3.68289772	0.686489993
Recorded/YouTube	3.656587302	0.998155202
H5P	3.647424116	0.999501853
External	3.419312169	1.308083356

In the analysis, the Moral Machine (Max Planck Institute et al. n.d.) and Cyber Games (NCA n.d.) interfaces were classified as unique authoring tools. These tools offer well-integrated, immersive multimedia, and learners found them intuitive and engaging, leading to the highest ratings. On the contrary, other external applications relate to the hands-on projects aimed at enhancing learners' proficiency in the application of AI tools for project management, video content creation, automated document handling, and financial analysis and forecasting. These tools attained the most polarised learners' opinions, with ones being very satisfied, others – and dominating – dissatisfied, and hence scoring, on average, the lowest. This finding suggests that due to differences in learners' previous experiences with AI tools and varied self-direction levels, the success of subject-specific external authoring tools is fragile and difficult to sustain in a self-paced asynchronous learning environment. Previous e-learning experience, digital literacy, online learning experience or utilising user-friendly technology are factors often identified as determinants of the effectiveness of e-learning (Noesgaard & Ørngreen 2015, Regmi & Jones 2020, Castro & Tumibay 2021). Without immediate support, using new software can overwhelm learners and reduce satisfaction.

As the results indicate, Moodle and SCORM offer a more consistent and reliable user experience, while H5P has more variable reactions. Although Moodle, SCORM and H5P are all widely used in digital learning (López et al. 2021), Moodle and SCORM-based activities were rated slightly higher than H5P, and their SDs were lower, meaning learners found them more consistently satisfying. Moodle and SCORM support structure, predictability and clarity, which are especially valued in digital learning contexts. H5P is more interactive and has a high potential for engagement and interactivity, but its success depends on design quality, technical execution, and alignment with learning readiness and objectives (López 2021, Rama Devi 2022). The data suggests H5P was less consistently effective, aligning with theoretical concerns about learner overload.

The slightly higher ratings of Heyzine than those of recorded videos resonates with the previous insights that interactive readings could be more positively received than video content by learners, which contradicts a broadly supported video-based learning (Lackmann et al. 2021, Seo et al. 2021, Liao & Wu 2023). As mentioned earlier, different video characteristics can also lead to different levels of student engagement and satisfaction.

4.2.5 Consistency in Learner Satisfaction

Ultimately, it is obvious from the table that there is a clear inverse relationship between average learner satisfaction by authoring tool and consistency of ratings: the higher the satisfaction rating, the more consistent the feedback ($r = -0.77$). Highly rated tools are reliably well-received across different learners, while lower-rated tools are more divisive — some love them, and others dislike them. This could reflect differences in user experience, learner preferences and readiness, or inconsistent implementation (Noesgaard & Ørngreen 2015, Regmi & Jones 2020, Castro & Tumibay 2021). It is important to note that consistency in satisfaction may be just as important as the average satisfaction itself. High variance can signal accessibility issues, unclear expectations, mismatched learning styles, etc. In general, as the results indicate, platforms with higher learner satisfaction tend to have lower variability, while platforms with lower satisfaction are more polarising.

4.2.6 Correlation with Grades

The Pearson correlation between grades and satisfaction ratings is approximately 0.53, suggesting a moderate positive relationship, as shown in Figure 4.

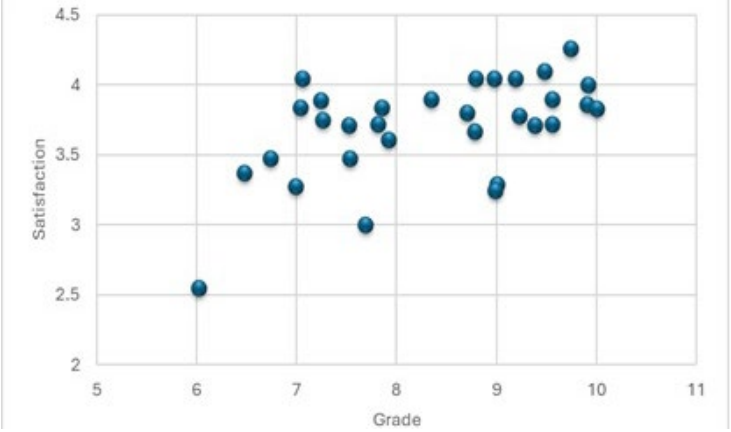


Figure 4: Scatter plot of learner satisfaction and grades

Activities that rank higher in grades also tend to rank higher in satisfaction, but with some variation. Interestingly, in case studies, higher grades were associated with lower satisfaction (r = -0.6), possibly suggesting a mismatch in expectations. For Moodle quizzes, a very weak positive correlation is observed (0.09), meaning that received grades and satisfaction do not relate much, possibly due to quiz objectivity.

On the contrary, in hands-on projects, the relationship between received grades (i.e., performance), and learner satisfaction is very strong (r = 0.99), supporting the assumption that learners derive satisfaction from success in complex tasks (Chis 2018, Wang & Wu 2022). However, the relatively high standard deviation in project satisfaction indicates that while some learners find projects highly rewarding, others struggle. This underscores the importance of scaffolding, particularly in asynchronous, self-paced online environments where learners navigate complex tasks independently. This highlights the need to further explore the use of complex tasks with CBL or PBL formats in e-learning (Ebbini 2023).

5. Conclusion

The findings of this case study, on the one hand, support several general statements established in educational research, such as: active learning is more dependent on learner profiles than passive learning; learners derive satisfaction from success in complex tasks; there is a need for greater scaffolding in implementing complex learning experiences, such as challenge-based learning. On the other hand, several findings oppose the common trends and might be specific to micro-credentials. For instance, passive learning activities were found to be almost equally satisfactory as the active ones, thus suggesting that, in elective asynchronous distance learning, passive means of acquiring knowledge are as attractive as the active ones. In addition, when evaluating learner satisfaction, it is not enough to rely on the activity format. Since learner satisfaction is affected by the content and specific features of offered activities, the comparison of activities requires a more complex approach and further research. Hence, as opposed to mainstream research, readings gained higher learner satisfaction rates than videos in the examined micro-credential.

From the perspective of the micro-credential design, it is important to mention that, in general, learners appreciate the rich variety of learning activities which invoke different educational techniques and authoring tools to better satisfy various learners' needs. Nonetheless, it is also true that well-integrated platforms which include multimedia and gamification elements are reliably well-received across most learners, while lower-rated tools divide learner opinions. Hence, an online micro-credential requires a balanced and thoughtful approach towards the variety, types and characteristics of its constituents.

Ethics Declaration

The authors declare that they have no conflict of interest and that all ethical standards regarding research integrity and participant consent were strictly observed throughout the study.

AI Declaration

The authors used Grammarly to improve the readability of the article. The authors reviewed and edited the content and take full responsibility for the content of the published article.

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Innovation Balancing Enterprise Capabilities and Local Technological and Consumer Requirements

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Abstract: This paper explores the development of an innovative skylight solution adapted for the Sri Lankan market, focusing on the transfer of corporate insights from temperate to tropical climates. It highlights the collaborative efforts with GOODLITE to optimize design, materials, and technology for tropical conditions. The study identifies key challenges such as high humidity, intense solar heat, and heavy monsoonal rains, and proposes solutions like the TropiLite Skylight. Overheating is an evident challenge that needs to be addressed when introducing western designed solutions from cooler climates into new markets characterized by higher solar exposure and more intense temperatures. By offering innovative solutions to address overheating, GOODLITE could unlock new market opportunities and drive growth by adapting to local climate challenges while staying true to their core values and preserving the unique qualities of their products that set them apart in a competitive global landscape. The research emphasizes the importance of modular and customizable designs to cater to diverse economic segments, ensuring affordability and functionality. This study also investigates useful strategies that could be used to introduce a foreign product into a new market by leveraging localized marketing, strategic partnerships, and product adaptations to meet regional needs. However, for long term success, the local ecosystem must also evolve, developing the necessary infrastructure, technical skills, and maintenance capabilities to support and sustain the introduction of such products. Hence, the study leverages on GOODLITE's expertise in skylights and roof window innovation and brings forward the experience in bringing market adapted solutions to new markets to ensure the proposed solution is suitable. The study demonstrates how strategic adaptations can address local climatic and market needs, paving the way for a scalable solution that could be used in tropical regions across the world. Through entrepreneurship, the introduction of a new skylight product to a foreign market aims to address specific consumer needs by offering a climate adapted solution.

Keywords: Innovation, Entrepreneurship, Skylight, Localized Adaptation, Tropical Climate.

1. Introduction

The global construction industry is undergoing a pivotal transformation, driven by the urgent need for sustainability, climate resilience, and market specific innovation. Innovating for sustainability means creating durable, climate resilient solutions that deliver long term value to stakeholders while addressing global environmental and social challenges and reducing reliance on disposable consumption (Chabowski, B.R. et. al, 2025). Skylights and roof window systems are seen as key enablers of green building practices. By enhancing the inflow of natural light, promoting passive ventilation, and reducing reliance on artificial lighting and mechanical cooling. Integrating innovation early in building design, particularly in optimizing window systems enables energy efficient, cost-effective solutions that enhance thermal performance, occupant comfort, and environmental sustainability in response to climate and health challenges (Ma, Q. et. al, 2025). The development of skylight solutions reflects the complex reality of sustainable transitions while embodying innovative solutions for tropical climates, it also highlights the disparities and challenges that developing nations face in balancing resource limitations with global sustainability expectations (Dsilva, J. et. al, 2025). While these products have seen success in temperate regions, their effectiveness does not always translate seamlessly across geographic and climatic boundaries. Furthermore, wellbeing has been validated as an importance since there has been a change of lifestyle among urban dwellers, especially in medium- to high-income groups, who tend to spend more time indoors nowadays (Ahmed, K. S., 2003). These changes are likely to contribute to increased use of air conditioning and thus higher energy use.

This paper focuses on regions characterized by Tropical climate conditions such as Sri Lanka, which present a distinct set of environmental challenges that complicate the adoption of skylight and roof window technologies developed for other climates. High humidity, persistent solar radiation, heavy monsoonal rainfall, and elevated ambient temperatures impose significant demands on building materials (Jayawardena et al., 2024). This demands specialized design considerations that address not only performance and durability, but also user comfort and safety. Furthermore, technological innovations have to be an integral aspect of the entire concept development. Especially to prevent water leaks, which is a common issue in regions with heavy rainfall (Ratnaweera & Hestnes, 1996). The paper explores the case of the TropiLite Skylight, an innovative solution that can be used as a blueprint to similar markets. The TropiLite represents a compelling model of how global firms such as GOODLITE which has been taken as the main company of focus for this study could leverage their

technological expertise while engaging in meaningful partnerships with local actors to create context sensitive products.

The TropiLite case thus serves as a practical example of sustainable innovation adapted for emerging markets, offering insights into the strategic fusion of global innovation and local adaptation. Lastly, it is valuable to realise that companies such as GOODLITE could transform climate challenges into opportunities for innovation and resilience, aligning with strategies that leverage environmental imperatives to drive sustainable growth (Rani, S.Y. et. al, 2025).

2. Literature Review

Understanding the interaction between architecture and climate is essential in tropical regions such as Sri Lanka, where high temperatures, humidity, and intense rainfall shape the built environment. Sri Lanka, specifically Colombo, offers a representative case due to its hot-humid climate, dense urbanization, and associated environmental pressures. Other regions that share maritime-tropical climatic similarities with Sri Lanka (Jayawardena et al., 2024), including Southeast Asia (Thailand, Malaysia, Indonesia), parts of Central America (Costa Rica, Panama) and tropical islands such as the Maldives, faces comparable challenges (Beck, H. E. et al., 2018). The implications are both architectural and social, 99% of the tropical population resides in developing countries, with significant growth expected by 2050 (United Nations DESA, 2019; State of the Tropics Report, 2014). Aligned with Adenle et al. (2015), this work acknowledges the importance of innovation diffusion in addressing climate challenges. Overheating in tropical dwellings reduces indoor comfort, raises energy demands, and exacerbates health risks. Passive design strategies, including optimal orientation, thermal mass, cross ventilation, and external shading are vital in mitigating overheating. Window orientation along east-west axes and shaded facades limit solar gain (Zune et al., 2021; Farrokhirad et al., 2024). Over glazing poses risks, increasing internal heat loads and glare. Thus, careful sizing and placement of skylights become critical. The A/V (area to volume) ratio also influences thermal performance, compact structures fare better in minimizing surface heat transfer (Rob et al., 2024). Findings from Ghosh and Gomes (2020) support these approaches, identifying natural ventilation and daylighting as essential for comfort and efficiency in Sri Lankan homes. Additionally, Mlakar and Štrancar (2011) and Bruno et al. (2017) emphasize the risk of overheating even in passive buildings, reinforcing the relevance of shading, glazing, and thermal mass solutions. Furthermore, from a human context of wellbeing, lighting influences not only energy efficiency but also circadian rhythms, mental health, and safety. Natural lighting reduces the need for artificial light and has therapeutic effects, improving mood and concentration (Van Bommel & Van den Beld, 2016). Design tools like the Daylight Factor (DF) and GOODLITE Daylight Visualizer help assess performance in residential settings (Dolnikova et al., 2020). Ventilation is equally crucial. Natural ventilation reduces reliance on air conditioning but must be protected from outdoor pollutants and insects.

Sri Lanka's Urban Development Authority outlines building regulations for light, ventilation, and room height, yet lacks specific codes for skylights. This regulatory gap highlights the need for market specific innovations aligned with global standards. International codes like EN 12207 (airtightness), EN 14449 (laminated safety glass), and ASTM E331 (water resistance) offer benchmarks for tropical performance. Roof windows present a viable solution for enhancing daylight and ventilation, particularly in rooms with limited wall space. However, tropical climates demand careful material selection. Anodized aluminum provides lightweight strength and corrosion resistance, while uPVC offers affordability and thermal efficiency. Laminated low-E glass helps manage solar heat gain, glare, and UV exposure (Sinha & Kutnar, 2012; Farrokhirad et al., 2024). Material innovations discussed by Wielage et al. (2008) and Moghaddam et al. (2021) support the use of anodised aluminum and modern glazing technologies to withstand tropical humidity and sunlight. Modular product design, as explored by Psomas et al. (2017), allows customisation and market flexibility for mass or premium consumer segments. Finally, integrating smart technologies such as rain sensors, automated ventilation, and solar powered actuators can optimize energy use and user comfort in skylights. These innovations reflect a shift toward responsive environments where users control and interact with building systems for improved wellbeing and efficiency (Hansen et al., 2013; Psomas et al., 2017). In Sri Lanka, the introduction of modular, scalable, and intelligent roof window systems offers a pathway for climate adaptive, consumer centered innovation. Innovation diffusion principles (Adenle et al., 2015) and entrepreneurial localisation strategies support this adaptive and inclusive innovation journey.

3. Methodology

This research adopted a mixed methods approach of both quantitative and qualitative, to ensure a comprehensive understanding of both consumer needs and expert perspectives regarding skylight solutions suitable for tropical climates, particularly in Sri Lanka. This was combined for context specific and innovation driven product development process. Quantitative data were collected through an online consumer survey, distributed to 270 Sri Lankan homeowners and prospective homeowners across various income brackets, the flexibility to carry out the data collection remotely made this method appropriate for this study. The survey explored demographic profiles, housing preferences, window usage behavior, material and technology choices, climate adaptation challenges, and willingness to invest in skylight products. For qualitative insights, semi-structured interviews were conducted with two Sri Lankan architects and two civil engineers, selected for their experience in tropical construction environments. These expert interviews explored technical feasibility, design integration, material suitability, regulatory factors, and cultural preferences. In addition, in-depth interviews were held with an innovation and a material & technology expert from GOODLITE, to validate technical decisions, assess design concepts, and evaluate potential testing methods. Interviews were conducted online using Microsoft Teams, recorded, transcribed using AI tools, and analyzed using thematic analysis to extract key themes and recommendations. Carrying out expert Semi-Structured Interviews (SSI), allowed for follow up queries to be performed and for open ended exploration to take place, which helped to improve the data-richness (Wilson, C., 2014; Adams, W. C., 2015). A case study approach centered on Colombo (Sri Lanka) was adopted to focus on real world applicability, this gave opportunities to develop suitable theories by the application of in-depth insights from the knowledge base and the environment. The study was further guided by a dual framework methodology combining the FuGle Innovation Process Model and Design Thinking (Louw et al., 2018; Carlgren, L. et al., 2016; Buhl, A. et al., 2019), ensuring structured innovation with user centered design principles. These frameworks enabled iterative ideation, conceptualization, and refinement of a skylight solution.

4. Case

GOODLITE, a multinational company, pioneered the modern roof window by combining daylight and ventilation in a compact, functional design. GOODLITE has maintained a strong focus on enhancing the quality of indoor environments through innovation in roof windows, skylights and sun tunnels. Their signature product model represents decades of iteration and market adaptation. With global reach across Europe, North America, and Asia. Adapting to tropical markets like Sri Lanka introduces new challenges. Unlike Japan, Sri Lanka's climate requires a bottom-up redesign, consistent with insights from innovation diffusion theory (Adenle et al., 2015). Furthermore, business capability mapping enables companies like GOODLITE to identify bounded innovation capabilities and strategically pursue commercial or cooperative transactions to complement them. This approach aligns internal capability diagnostics with adapted external partnerships, driving innovation through targeted resource and knowledge exchange (da Silva Nascimento, L. and Zawislak, P.A., 2023). This is essential in adapting to new markets that require products to fit local needs. In addition, global entrepreneurship thrives when it balances local adaptability with cross-border collaboration, and emerging markets can harness this synergy by building entrepreneurial cultures that are agile, innovative, and globally connected (Emma, L., 2025). This is critical for GOODLITE to make a seamless entry into a new emerging market such as Sri Lanka.

Balancing global innovation with local adaptation is essential for GOODLITE to remain competitive and responsive in diverse markets. This approach, often referred to as "glocalization," emphasizes the importance of adapting global strategies to fit local contexts, ensuring that innovations resonate with regional needs and preferences (Barakat, L. et. al, 2025). In terms of local context, in this study Colombo is the focus area, it is the commercial capital city of Sri Lanka, exemplifies both the challenges and opportunities for sustainable skylight design. The central business district (CBD) suffers from poor ventilation and low natural light due to urban congestion and shadowing from tall buildings; the outskirts maintain more breathable residential layouts. Sri Lanka's architectural tradition emphasizes passive cooling and ventilation. Historic and vernacular structures utilized high pitched roofs, shaded eaves, and natural materials to manage solar gain and humidity. However, globalization led to widespread use of energy intensive materials and solutions, including extensive glazing and air conditioning (Ratnaweera & Hestnes, 1996).

Temperatures in Colombo average 28–31°C year-round, with high humidity and distinct monsoon seasons bringing heavy rainfall (Sri Lanka Department of Meteorology, 2024). The city experiences sharp fluctuations in sun hours throughout the year, from 9 hours in January to nearly zero in May. Peak rainfall occurs in May and

October, each receiving over 300 mm. These conditions demand skylight systems that can manage solar gain, allow ventilation, resist moisture ingress, and withstand intense UV exposure. The city's location in the wet zone of Sri Lanka means it receives over 2,500 mm of rain annually, with additional inter-monsoonal rains offering intermittent but intense downpours. The urban middle and upper-middle class in Sri Lanka prioritize visual comfort, thermal regulation, and modern aesthetics. Market dynamics show the dominance of SMEs in the construction sector, limited access to advanced training, and inconsistent recognition of sustainable building practices. Regulations by the Urban Development Authority (UDA) and Colombo Municipal Council stress the importance of natural light and ventilation but lack specific guidelines for skylights. Urbanization has amplified the heat island effect and increased cooling loads, reinforcing the value of passive lighting and ventilation.

5. Findings

This study presents a data-driven approach to designing the TropiLite Skylight by aligning climatic realities with consumer preferences in Sri Lanka. Colombo's tropical environment is marked by high temperatures (28°C–31°C), humidity (73%–87%), and intense rainfall necessitates skylights that are waterproof, UV protected, impact resistant, and mosquito proof. Features such as StormSafe Glass, EPDM drainage, and insect proof ventilation address these challenges. Consumer insights show strong demand for skylights that are stylish, durable, and functional. Most respondents were young professionals (67.4% aged 25–34), many of whom were homeowners with moderate to premium incomes. Most preferred single-family homes (57.8%) and favored a blend of Western and Sri Lankan architectural styles (52.6%). Key functional priorities included natural light (91.5%), ventilation (84.4%), weather resistance (83.7%), and durability (82.6%), alongside a preference for low maintenance (79.6%) and customizable solutions whether manual or automated depending on budget. These findings emphasize the importance of localized, modular innovation that balances design, climate adaptation and affordability.

6. Skylight Solution for Tropical Climates

Innovative product design that aligns with emerging market needs is crucial for GOODLITE aiming to achieve sustainable growth and maintain a competitive edge in today's dynamic business environment (Shehab, S. et. al, 2025). By integrating customer insights, market research and advanced technologies, GOODLITE could develop and offer products that not only meet current demands but also anticipate future trends, ensuring long term success keeping in mind their goal of mass volume sales as a key driver.

6.1 TropiLite Skylight

With support from GOODLITE experts, a new product concept, the TropiLite Skylight has been developed through an iterative design process that incorporated insights from potential end users and in-depth climate analysis. Several concepts were proposed, but the most viable solution that was attractive to have as an initial market offering was chosen. While GOODLITE's existing range of center-pivot windows, solar-powered skylights, and smart ventilation systems serve temperate regions effectively, these models were not fully suited to Colombo's unique tropical climate. As a result, the TropiLite Skylight emerged as a purpose-built innovation, reflecting a strategic departure from product adaptation to a regionally embedded design approach. Developed in alignment with the Fugle Method, focusing on Function, Usability, Goal, Limitations, and Evolution, the TropiLite Skylight is a modular and scalable product that supports a range of consumer budgets and roof types. Its design evolution was guided by GOODLITE's global mission to deliver daylight and fresh air into buildings while rooting innovation in the specific socio-economic and climatic conditions of Colombo.

The study has identified key enablers that offer potential solutions to address the challenges specific to tropical regions. These enablers demonstrate how skylights, originally designed for temperate climates, could be adapted to suit tropical conditions. **Figure 1** illustrates these enablers.

6.2 Skylight Innovation Enablers - Temperate to Tropical Climates

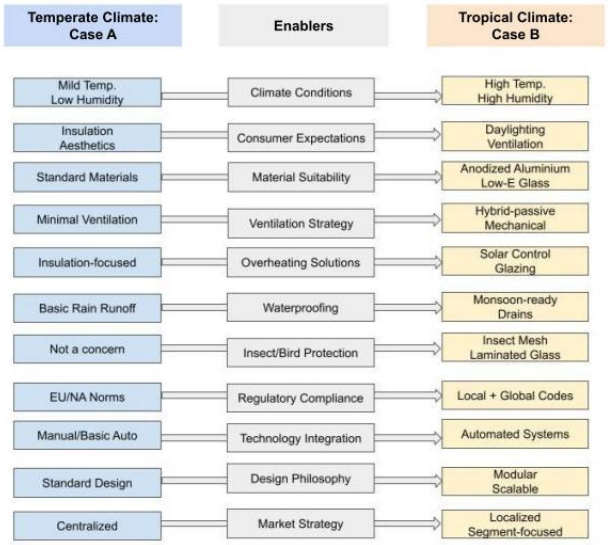


Figure 1: Transition from Temperate to Tropical Skylight Innovation: Enablers (Self-developed by Author)

The development of the TropiLite Skylight followed a human centered design approach using design thinking. In the Empathy phase, field research identified issues like overheating, poor ventilation, and limited passive cooling. The Define stage clarified goals such as weather resilience, affordability, modularity, and architectural fit. During Ideation, key innovations including TropicFrame, SunGuard Glazing, AeroFlow Ventilation, and RainGuard Drainage were conceptualized. The Test phase will include performance evaluations under simulated monsoon conditions, solar heat gain analysis, and wind load assessments. The final design combines essential components such as TropicFrame, SunGuard Glazing, RainGuard Drainage, StormSafe Glass, and UVDefender coating with optional features like AeroFlow Ventilation (manual/automated), CoolShade System (internal/external blinds), and RainShield Sensors for automatic rain response. Based on expert and user feedback, EPDM seals, impact resistant glass and weatherproof coatings, ensuring durability, comfort and smart functionality. The main features are shown on the TropiLite concept model in **Figure 2** below.

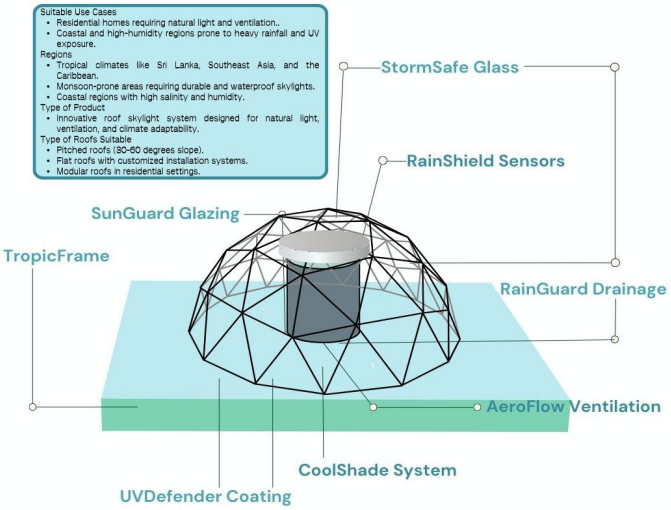


Figure 2: TropiLite Skylight (Self-developed by Author)

7. Discussion

Developing a roof window solution for Sri Lanka required a fundamental rethinking, rather than retrofitting a temperate climate design for tropical use, this study adopted a bottom-up, context driven innovation transfer strategy. This is because innovation can be costly, apart from certain R&D efforts, absorbing external knowledge through technology transfer is considered an alternative method to support innovation (Wang, Y. et. al, 2025). The hot-humid urban climate of Colombo comes with distinct architectural challenges such as high solar

radiation, humidity, and intense seasonal rainfall (Jayawardena et al., 2024; Beck et al., 2018). Colombo, with its dense population of middle to high income urban dwellers, served as an ideal testbed for this study. The consumer insights obtained from 270 survey respondents confirmed strong preferences for natural light (91.5%), passive ventilation (84.4%) and stylish design, showing a clear market opportunity for skylight solutions. These insights align with the importance having daylighting and ventilation in tropical residential architecture (Ghosh and Gomes, 2020). The design of the TropiLite Skylight was supported by Design Thinking and the Fugle Innovation Process Model (Carlgren et al., 2016; Louw et al., 2018), promoting an iterative and empathetic development with direct target consumer input. The TropiLite Skylight integrated passive design principles vital for tropical comfort. Overheating is a major challenge in tropical architecture, mainly due to the excessive glazing and poor ventilation (Mlakar & Štrancar, 2011; Bruno et al., 2017). To avoid these risks the skylight was designed with shading features to control daylight penetration and also manage the solar heat gain. The use of laminated low-emissivity (low-E) glass in the SunGuard Glazing system reduces glare, blocks UV radiation and prevents indoor overheating (Farrokhirad et al., 2024). Furthermore, every building reflects unique and customized characteristics shaped by consumer, social and cultural preferences inherited from ancestral traditions, this emphasizes the need for design and material choices that respect and integrate these local values (Gurupatham, S.V. et. al, 2024). Hence it was crucial in addressing Colombo's coastal and humid climate. The TropicFrame, built from anodized aluminum, offers corrosion resistance and long-term durability, which are local requirements that had to be fulfilled (Wielage et al., 2008; Moghaddam et al., 2021). In addition, the AeroFlow Ventilation system enhances cross-ventilation while including insect proof mesh to protect against vector-borne diseases like dengue (Messina et al., 2014; Puppim de Oliveira et al., 2011). The modular product architecture enables customization across budget levels and housing types. This supports the principles of inclusive innovation and entrepreneurial localization strategies essential for tropical market diffusion (Adenle et al., 2015). To protect the product's key innovations, especially the features, having Intellectual Property Rights (IPR) frameworks are crucial. Legal tools such as patents, trademarks, design rights and NDAs with partners are recommended to prevent imitation and secure competitive advantage (Narwaria et al., 2024). These protections are important as Sri Lanka is envisioned not only as a domestic market but as a strategic blueprint that could be used to enter other maritime tropical regions such as Southeast Asia and Central America (Beck et al., 2018).

8. Conclusion

Technological innovation serves as a critical differentiator for multinational companies like GOODLITE, particularly in the context of emerging markets where climate specific demands and consumer aspirations are rapidly evolving. This collaborative, research-based initiative aimed to develop a skylight product suited for the Sri Lankan market by synthesizing localized consumer insights with GOODLITE's global design and engineering capabilities. The study led to the conceptualization of the TropiLite Skylight, a purpose-built solution adapted for tropical climates, with Colombo as the primary case study. A bottom-up innovation strategy was adopted, resulting in the TropiLite Skylight, featuring TropicFrame for structural durability, SunGuard Glazing for thermal control, RainGuard Drainage for waterproofing, and CoolShade for improved occupant comfort. These design elements directly address core challenges such as overheating, poor ventilation and insufficient daylight, as identified by both consumers and professionals. To secure long-term competitiveness, GOODLITE must complement product innovation with robust Intellectual Property Rights (IPR) strategies. These legal tools can help safeguard proprietary technologies as the company scales its offerings to similar tropical markets. In addition, strategic partnerships and knowledge exchange with local actors can support smoother market penetration and after sales support. However, this study presents certain limitations. The primary focus on Colombo, while representative, may not capture regional diversity across Sri Lanka or other tropical contexts. Similarly, expert interviews, though insightful, were limited in number and could benefit from broader stakeholder inclusion, such as regulators and builders. The product's performance, although conceptually validated, awaits empirical testing under real world climatic conditions. Future research should prioritize prototyping and field testing of the TropiLite Skylight under varied tropical weather scenarios to validate durability, thermal performance and user experience. In conclusion, the TropiLite Skylight shows how climate adapted, consumer driven innovation, rooted in interdisciplinary collaboration can result in context specific solutions that support comfort and strategic growth in emerging tropical markets.

Ethics Declaration

This study has kept all stakeholders anonymous and no data is presented making stakeholders identifiable.

AI Declaration

Artificial intelligence tools, including language models provided by OpenAI for language proofing. In addition, the semi-structured interviews were transcribed using AI tools.

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Attracting Investors by Managing Psychological Challenges in the Perspective of Serial Entrepreneurship

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Abstract: Since many ventures fail the intriguing thing is that entrepreneurs continue to start new businesses despite the financial, emotional, and reputational damage. These business people are called serial entrepreneurs since they frequently fail and start new ventures. This condition indicates that people may have positive intentions despite their fear of failing because entrepreneurs may gain deeper insights from failure to stay motivated. This study employs a qualitative case study to investigate whether serial entrepreneurs process failure and extract lessons to improve future ventures for attracting new investors. Interviews were conducted among 5 serial entrepreneurs who experienced success after several failures and attracted a lot of investors. The result of the study shows that serial entrepreneurs experience failure, extract valuable lessons, and develop strategies to enhance future performance. A strong network is built by serial entrepreneurs to ensure social and financial resources for profitable business operations. Serial business owners can overcome psychological barriers and win back investors' trust to keep their company going.

Keywords: Serial entrepreneurship, Psychological challenges, Investment, Ecosystem.

1. Introduction

Despite the fact of successful entrepreneurship, a high failure rate is a regular phenomenon in this field (Klimas et al., 2021; Lee et al., 2022). These entrepreneurs known as serial entrepreneurs launch new companies while running their current ones or after failing and closing their current ones (Plehn-Dujowich, 2010; Westhead et al., 2005). These forms of entrepreneurship are also referred to as habitual entrepreneurship. According to a recent study, the majority of successful entrepreneurs almost 50% have prior failure-related experience (Mwatsika, 2021). Therefore, additional study is necessary to uncover the positive intention of serial entrepreneurs to continue their business (Kraus and Dasí-Rodríguez, 2020). Even Nevertheless, it is easy to forecast that entrepreneurs will suffer significant losses in terms of money, reputation, social standing, and mental health because many of them fail multiple times. These losses have an impact on their confidence and sense of self as business owners (Baù et al., 2017). Then, why do serial entrepreneurs keep trying? The study aims to determine what kind of motivation spurs them once more to identify the cause of their failures and get past them (Lin Shihui, 2018). The goal of this study is to determine what distinguishing characteristics these serial entrepreneurs have in contrast to portfolio entrepreneurs, who launch their businesses for the first time (Shaw Anders, 2019). Regardless of the exact condition that may seem contradictory, failure or success gives people greater confidence to decide to start over (Eggers Lin, 2015; Huang and Knight, 2017). Previous studies have also shown that several businesses have failed and left the market due to fear of social and financial loss (Detienne and Chirico, 2013). As a result of their failure, entrepreneurs have more opportunities to gain real-world business experience. Scholars have previously examined entrepreneurial re-entry and its distinct learning impact (Marmor and Lukason, 2024). Additionally, entrepreneurs are observed to learn from their prior experiences (Vazhapilly and Dam, 2024) and gradually enhance their performance (Dabić et al., 2023; Patel, Oghazi, and Izquierdo, 2022). Their chances of receiving complete funding from investors are occasionally hampered by entrepreneurial failure. Serial entrepreneurs are more likely to be able to see opportunities, while portfolio entrepreneurs are more likely to be able to explore those opportunities (Parker, 2013; Vaillant and Lafuente, 2019). The variables influencing serial entrepreneurship are intricate and challenging to comprehend (Dabić; et al., 2021). Since the comparatively dispersed points of view make it challenging to comprehend the underlying structure of how the complex variables affect serial entrepreneurial drive, it is imperative to construct a unified model. However, this study indicates that an entrepreneur may pursue a new venture after failing at their first one and that this new venture may have a better probability of succeeding than the first one. A distinct environment surrounds serial entrepreneurship, according to research. Serial entrepreneurs learn to bounce back from setbacks and regain investors' trust to continue their firms.

This study expands on our knowledge of how psychological barriers do not prevent serial entrepreneurship from succeeding. To achieve true success, entrepreneurs need a positive mindset. Investors provide these businesses with financial resources by combining entrepreneurial trials with psychological accomplishment. To ascertain whether managing entrepreneurship and attracting investors is feasible, this study examines the psychological challenges faced by serial entrepreneurs through interviews.

Below, the research questions are formulated:

1. How do serial entrepreneurs manage themselves in the serial entrepreneurship ecosystem?
2. How do serial entrepreneurs renew the confidence of investors to fund their ventures?

2. Literature Review

2.1 Risk and Psychological Factors in Serial Entrepreneurship

Serial entrepreneurs are not restricted to a single business venture. According to Lahiri Anu, A.W. (2020), they are representations of entrepreneurial active groups, and serial entrepreneurship is becoming more and more popular worldwide. According to Chen J. (2013), research on serial entrepreneurs is essential to comprehending entrepreneurship and entrepreneurs in general, and the sustainability of entrepreneurship in particular. Research indicates that serial entrepreneurs may have a higher chance of long-term success (Fu and Wennberg, 2018) and exhibit a more optimistic outlook on failure as an entrepreneur (Dabić et al., 2023). Using their prior entrepreneurial experience as a guide, serial entrepreneurs analyze their re-entrepreneurship behavior. An impression created by the person's work experience will influence their conduct for a long time (Simsek et al., 2015). According to Aghelie, A. et al. (2016), when an entrepreneur starts a new business, their experience will be transmitted, and they frequently use their prior information processing mechanism to make judgments. They also continuously influence the expansion of the new business. Serial entrepreneurs may benefit from the experience imprinting effect by expanding their resources and improving their abilities (Peng et al., 2020), which will then positively impact their entrepreneurial behavior when they launch a new company. However, unsuccessful business ventures can cause social, economic, and psychological crises for serial entrepreneurs. First of all, to recover from the psychological traumas brought by entrepreneurial failure and progressively escape the situation by considering the causes of failure and gaining confidence, serial entrepreneurs who have experienced entrepreneurial failure frequently have to pay a certain emotional value (Dutta and Sobel, 2021; Lattacher Malgorzata A., 2020). Secondly, excessive loss can also lead to economic crises for individuals or new organizations, and serial entrepreneurs must also pay for property losses from past business failures (Tipu, 2020; Williams and Lindh, 2020). Last but not least, serial entrepreneurs who fail to launch a business will face social stigma, which could negatively affect their ability to obtain funding and grow their market in addition to affecting the validity of future business starts (Al Halbusi et al., 2024; Hunter et al., 2021). Serial entrepreneurs may even be unable to obtain complete funding for their following business start-up due to their entrepreneurial failure experiences. It can be difficult for entrepreneurs, especially serial entrepreneurs, to completely rely on innate behavioural tendencies. Previous studies have demonstrated that the external ecosystem of entrepreneurship will impact the efficacy and entrepreneurial intention of entrepreneurship. Additionally, the entrepreneur's prior crisis management expertise might help businesses communicate easily to get support (Mwatsika, 2021). The social environment can also impact businesses to increase resilience in times of social crisis, in addition to the dynamic talents of entrepreneurs themselves (Espinoza and Diaz, 2021). Additionally, entrepreneurs can improve their organization's crisis-handling skills, adaptability, and resilience by reflecting on and learning from past events (Santos, et al., 2020).

2.2 Performance of Serial Entrepreneurship

Entrepreneurs that successfully learn from their past experiences are guaranteed to perform better. The four phases of this learning process are experience, contemplation, conceptualization, and experimentation (Peng et al., 2020). For learning to be effective, the experience stage needs to be deep and intense to trigger the subsequent stage of reflection. The most important phase for successful learning is frequently the reflection stage, which entails a thorough and deliberate assessment of the experience's results (Lattacher Malgorzata A., 2020). According to Al Halbusi, H. et al. (2024), serial entrepreneurs frequently ignore this stage, fail to adequately reflect on their mistakes, and attribute their failures to outside forces like the state of the economy. This may account for their propensity to launch new businesses and fail at them (Deichmann Jan, 2014). Failure is likely to have a greater learning effect since previous business failures are more likely to result in such intense

experiences. However, while his or her expectations were mostly met, previous success does not always give an entrepreneur more knowledge (Vazhapilly and Dam, 2024). High performance at previous firms is therefore likely to result in the status paradigm being maintained in their new firms, while poor performance is more likely to result in change, given the persistence of performance between serial entrepreneurs' enterprises. Due to the ambiguity surrounding entrepreneurial re-emergence following failure (Patel, Oghazi and Izquierdo, 2022) and the lack of proper reflection following the failure event, the evidence currently supporting learning from entrepreneurial failure is weak. Prior research suggests that serial entrepreneurs enhance their company success by learning by doing, managing several businesses, and building up social and human capital (Dabić, et al., 2021). Regardless of whether their prior attempt was successful or not, some research has shown that serial entrepreneurs gain from subsequent experiences, with the financial performance of their new businesses improving over time (Paik, 2013). Conversely, other research has shown that the advantages of learning by doing are negligible or non-existent and that as entrepreneurial experience increases, cognitive overload increases as well (Peterson Andy, 2021), making it more difficult to make the most of the experience. Entrepreneurs may find it challenging to apply their prior expertise due to the uncertainty involved in launching new companies (Spanjer Arjen, 2017). Successful businesspeople frequently exaggerate their capacity to duplicate their past successes in new ventures (Nielsen Saras D., 2016). Additionally, overconfident entrepreneurs are less able to adjust to new challenges and complexity, which reduces the impact of prior learning (Hamori Burak, 2014). One predictable characteristic of serial entrepreneurs is overconfidence, which can cause less successful entrepreneurs to launch new ventures more frequently than successful ones. To determine how to logically distribute psychological motivation across the entrepreneurial ecosystem to secure their business expansion with the assistance of investors, this study uses serial entrepreneurs as its research object.

3. Research Methodology

A qualitative research methodology is used. Understanding actual situations is aided by case analysis (Yin, 2018). Qualitative research aims to interpret people's mind constructions, or how they understand their experiences and work in the world (Merriam and Grenier, 2019). The analysis is done by coding with MAXQDA (Silver, 2017). Semi-structured questionnaires were used in in-person interviews for collecting primary data. As part of the data triangulation process, serial entrepreneurs were interviewed. To identify the exploration of serial entrepreneurship, brochures, websites, and publications are considered as secondary data (Maxwell, 2012). Around forty-minute individual interviews were conducted between November and December 2024. To understand the reason behind overcoming psychological obstacles and motivating investors 5 interviews were analysed through coding.

4. Analysis and Findings

4.1 Cases of Serial Entrepreneurship

Table 1: Cases of serial entrepreneurship

Entrepreneur 1	Jony and a few of his friends launched a furniture company. His firm grew quickly in the beginning, and a lot of people wanted to invest. Despite their success, they were having trouble in their business due to the fierce competition in the market. Although the situation of the firm depressed Jony, he refused to surrender to the loss and instead began looking into the true cause of the problem. He discovered that his products are no longer distinctive since a large number of competitors with greater resources and experience have already entered the market. Jony changed his business from making furniture to designing interiors, and he employed all of his timber materials for this purpose. He conducted in-depth market analysis and approached more investors with budgets. A more competent team was assembled, and more thoughtful decisions were made by drawing on prior knowledge.
Entrepreneur 2	Rafsan is a British entrepreneur who comes from Bangladesh. He was completely alone and new in that country at first. When he first opened his restaurant, he was not fully aware of the target market, product costs, or the customers' favourite menu. He had a limited budget and was unfamiliar with British banks. He began using his own money, but after a few days, he discovered that his success was not as great as that of his competitors. After considering a partnership, he quickly merged with a small, successfully operated restaurant. He got to know competitors and their operations. He did not limit himself to that partnership business only; in addition, he started his own restaurant.
Entrepreneur 3	Tina has always wanted a bakery because she loves to relax in these kinds of shops with lite food. She discovered that a number of consumers were interested in the business when she first started it because of the fresh baking aroma. However, a few months later, she realized that the profit was actually below average. She shut it and began identifying the flaw. She became aware that she had

	only thought of the business as a hobby. Consequently, she began studying branding, positioning, targeting, and cost management. The business got smarter once she reopened it.
Entrepreneur 4	Maya and her friends invested in an e-commerce company by utilizing all of their creative thinking. They had a great business idea, but they did not possess an excellent plan for developing an app or website. They therefore had a poor marketing plan and tried to attract clients in an ineffective manner. They began to lose money after a few months as their capital dropped. Maya quickly left the company after considering her incapability. But as time passed, she came to understand that this experience taught her more than just academic lessons. She became a co-founder of an e-commerce company and was familiar with its well-defined growth strategy. She began to succeed in this field of work.
Entrepreneur 5	Tomal's interest in fashion design led him to abandon his corporate employment. He launched his own fashion company with original concepts and designs, but he ignored consumer complaints about the material and comfort. He put a lot of effort and passion into his design work. Despite his disregard for his consumers, he discovered after a few months that many were moving to his competitors. Tomal closed the company and took a new job. He continued to pursue his idea, visiting various fashion and lifestyle-related brands, talking with customers, and creating a client database. A year later, he re-launched his brand and began to reap the rewards of his earlier setbacks.

4.2 Mechanism to Overcome Failure and Attract Investors

- Resilience is one of the qualities that allow entrepreneurs to deal with failures while continuing to strive for their business extension. Through seeking advice from mentors and advisors, an entrepreneur can improve their approach and take criticism into account. They have the chance to apply their agility and adaptability to new company ventures by learning from their errors. They develop the bonds inside the entrepreneurial ecosystem from the moment of failure until the present. Making connections with potential investors, attending networking opportunities, and taking part in startup communities all benefit entrepreneurs in attracting more funding.
- Serial business owners have the chance to interact with investors and share their failure- to-success narrative. They are moved by these stories and are given the information they need to make an informed investment decision. Investors appreciate successful exits. If the business begins to turn a profit after failing, it gives investors a more reliable view. These prior failures can also be regarded as valuable experiences.
- These serial entrepreneurs have greater faith in their present or future business strategy. Serial entrepreneurs are skilled at predicting what potential investors might consider investing in them. Investors want to see an idea that is ready to go into action right away. Though serial entrepreneurs are repeat or habitual business owners, they develop a suitable plan or blueprint.

Figure 1 indicates, the desire to establish one's identity as an entrepreneur helps them get beyond psychological obstacles, which allow them to persuade investors. After experiencing failure, serial entrepreneurs learn important lessons and create plans to improve performance in the future. Entrepreneurs who fail get more insight than successful competitors, which they use to make better decisions. To secure social and financial resources for successful business operations, serial entrepreneurs establish a robust network. An entrepreneur's viewpoint, reliability, and ability to learn from mistakes are defined by their ability to draw investors. In contrast, serial entrepreneurs can overcome challenges and regain the confidence of investors to maintain their businesses.

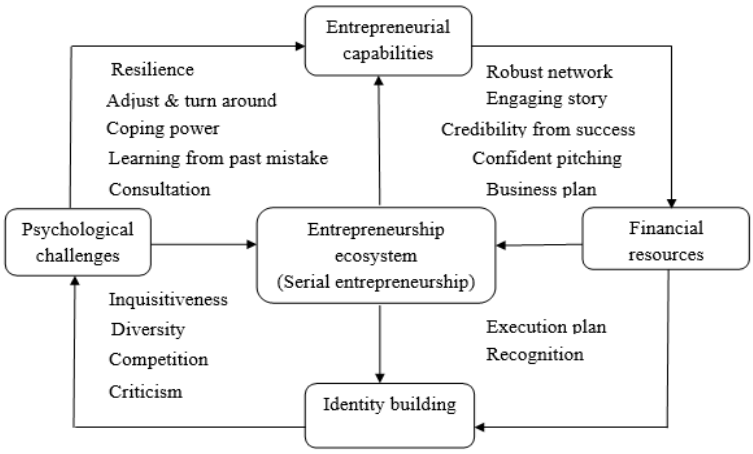


Figure 1: Attracting investors by overcoming psychological challenges

5. Theoretical Implications

The condition of an entrepreneur is determined by financial risk, competitiveness, and uncertainty (Marmor and Lukason, 2024). Determining how successful entrepreneurs respond in failure is challenging. Even noted, it is more difficult for serial entrepreneurs to decide to continue their business after experiencing failure (Vazhapilly and Dam, 2024). They may consider entrepreneurship again if they are highly motivated and build qualities to attract the investors. Their incorporation of new concepts, a business plan, self-assurance, in-depth industry expertise, and the capacity to overcome any obstacle propels them forward and aids in obtaining funding for their ongoing venture (Mwatsika, 2021). They are more appealing to investors due to their experience, which lowers perceived risk. Their entrepreneurial story and interesting case demonstrate the resilience of entrepreneurship by overcoming psychological barriers (Dabić; et al., 2021).

Ethical Declaration

The author stated no ethical clearance is required for this research.

AI Declaration

The author stated no AI support is utilized to develop the article.

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From Destructive Leadership to Good Leadership in Expert Organisations: Identifying the Determinants of Effective Leadership

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Abstract: Leadership culture in expert organisations strongly influences organisational well-being, employee retention and productivity. Destructive leadership, marked by authoritarian control, lack of transparency and neglect of employee welfare, erodes motivation and performance. Conversely, good leadership builds trust, fosters participation and supports professional growth. Drawing on eight semi-structured interviews with leaders in Finnish expert organisations of varying size, this study identifies the behavioural patterns that differentiate destructive from good leadership and proposes a development framework for practice. Reflexive thematic analysis was used; data saturation was achieved after the sixth interview and confirmed with two additional interviews. Results show that good leadership rests on: 1) values-based communication, 2) fairness and psychological safety, 3) shared decision-making, 4) strategic clarity and 5) systematic capability development. The study contributes to leadership theory by integrating destructive and constructive perspectives and advances the debate on sustainable work in knowledge-intensive contexts. Managerially, the findings point to organisation-wide interventions, rather than reliance on individual charisma, as the route to improved leadership quality and employee well-being.

Keywords: Expert Organisations, Leadership Development, Destructive Leadership, Good Leadership, Organisational Well-being, Employee engagement

1. Introduction

Work cultures are changing fast as demographic decline; technological acceleration and political volatility reshape labour markets. Expert organisations must therefore rethink leadership to keep employees healthy, motivated and productive. Theories of leadership are also increasingly influenced by calls for sustainability, social responsibility, and equity (Foss et al, 2022).

Using the empirical context of Finnish working life, the present paper focuses on destructive and good leadership styles, aiming to recognize and mitigate destructive leadership practices and identifying the key elements of effective leadership through empirical analysis. More specifically, the present study explores the dual nature of leadership (destructive and constructive) within expert organisations. The research questions this study seeks to respond to contribute to literature on leadership and sustainable work relates to the characteristics of good leadership in expert organisations: *What are the key components of good leadership and how does good leadership manifest itself in in expert organisations?* and: *what are the effects of good leadership on expert organisations and their employees?* We combine a literature review with eight semi-structured interviews to derive actionable lessons for sustaining long, healthy expert careers.

2. Literature Review

We consider both good and poor (destructive) leadership in light of their definitions and impact. First, the former type is a determinant of sustainable work ability, which in turn is grounded in individuals' physical and mental health as well as their social capabilities. Additional resources that contribute to work ability include education, skills, values, attitudes, and motivation. When these elements are in balance with working conditions, a person's capacity to work remains high. Work ability serves as a key indicator for both career longevity and the likelihood of taking sick leave. As individuals age, their mental and physical resources naturally decline. Simultaneously, changes in workplace technologies and environments present new challenges. The quality of leadership within work communities also plays a significant role. Poor leadership has a direct negative effect on employees' work ability (Kunz and Millhof, 2023).

Leadership culture, an integral component of work environment and fluency, is currently undergoing significant transformation. Traditionally, leaders were viewed as heroic figures driving organisational success at any cost. Literature and public discourse have often praised these figures, yet there has been less attention paid to the adverse outcomes of such leadership cultures (Juuti 2018, pp. 13–14). Today, researchers increasingly aim to

disaggregate harmful elements of organisational leadership into more precisely defined phenomena (Page and Mgwenya, 2023).

Leadership itself emerges when individuals follow someone in pursuit of a shared goal. It is shaped by the relationships between leaders, followers, goals, and the situations in which action is taken. Leadership is a communal phenomenon that is built via shared focus, collaboration, and problem-solving, all aimed at achieving a common purpose. It is a process shaped by dialogue, where reality is interpreted and aligned to fit the situation. Groups within organisations need leaders to help them work efficiently toward their goals. Effective leadership requires knowledge, decision-making ability, passion, consistency, and a clear sense of direction. It is about earning trust and preparing the team for future challenges, not about superiority, but about responsibility for the organisation's vision. (Deshwal and Ashraf Ali 2020, p. 38; Juuti and Juuti 2021, pp. 20–21; Wolor et al, 2021, p. 106).

Destructive leadership, on the other hand, refers to a leadership culture where leaders prioritize their own goals over those of the organisation. A destructive leader actively harms the organisation through various means to advance personal interests. It is defined as wilful behaviour by someone in a leadership position that damages or intends to damage the organisation or its subordinates (Alexander et al, 2024, p. 1). Destructive leadership can manifest through individual or group behaviours, or as a process within leadership itself (Alexander et al, 2024; Klahn Acuña and Male 2022, p.2). Destructive leaders often have traits that increase and spread a toxic organisational culture. According to Boddy (2023, p. 599), these leaders typically lack empathy, act ruthlessly, and tend to lie. These traits and behaviours can be either intentional or unintentional. Some leaders knowingly adopt harmful behaviours to serve their own goals, while others may do so unconsciously, especially in cultures where destructive leadership has become normalized (Lipman-Blumen 2005, pp. 29–30). Destructive leadership impacts the organisation at some level. Its effects can be seen both on the individual level, such as reduced motivation and commitment, as well as on the organisational level, through decreased productivity, poor collaboration, and high employee turnover (Klahn Acuña and Male 2022; Wolor et al, 2022; Saleem et al, 2021).

Destructive leaders often possess personal traits that support the development of a toxic leadership culture. Charismatic leaders may present a favourable image to select individuals while behaving harshly toward subordinates. They are typically highly ambitious and driven to pursue their personal goals at any cost (Lipman-Blumen 2005; Page and Mgwenya, 2023). The main traits of destructive leaders include a strong desire for power, narcissism, and ideologies that are enhanced by hostility. Narcissism is characterized by arrogance, self-centeredness, envy, low self-esteem, and a need for entitlement. Many destructive leaders also have negative personal histories (Page and Mgwenya, 2023) and such leaders aggressively seek roles that elevate their importance within the organisation. They often justify their dominance by claiming to protect the organisation from external threats. In pursuit of their interests, they may use fear and intimidation which can lead employees to discuss work matters in secret. Destructive leaders may also slander or belittle both their subordinates and superiors (Wolor et al, 2022).

In expert organisations, in which tacit knowledge, strong professional identity and peer-regulated coordination are particularly visible, leadership must balance autonomy with direction (Henry, 2019). Yet few studies isolate leadership phenomena in such settings (Page & Mgwenya, 2023). Recent Finnish studies show that generational value gaps moderate perceptions of leadership fairness and autonomy (Wolor et al., 2021). Generation X leaders accustomed to command-and-control styles may inadvertently trigger disengagement among generation Y/Z experts, who equate good leadership with participatory problem solving and flexible work rhythms. Integrating generational theory thus refines our understanding of leadership effectiveness in knowledge-intensive settings.

3. Method

A qualitative methodological approach was chosen, since it is best suited for exploring experiential knowledge (Valli and Aaltola 2025, p. 39). The chosen interview format was a thematic interview, which assumes that the topics discussed reflect the participants' subjective perceptions and experiences related to the research topic. It is also assumed that participants have encountered relevant processes and phenomena. The key themes, such as structures and processes were identified related to the phenomenon through prior studies or literature (Puusa and Juuti 2020, p. 112). Thus, a semi-structured interview method via thematic interviews was applied. Finland was chosen as the empirical country context for the study, due to the prevalence of knowledge work and expert organisations in its society, and since the context is suitable for studying organisational leadership practices in general (e.g., Koveshnikov and Ehrnrooth, 2018). A semi-structured interview guide was developed by mapping prior leadership constructs onto the COM-B behavioural model (Michie et al., 2011). Questions

probed capabilities, opportunities and motivations behind both destructive and constructive practices. The questions were as follows:

1. Definition – *How do you define good leadership in an expert organisation?*
   - Probe: What concrete behaviours signal it to you?
2. Value/Impact – *Why is investing in leadership worthwhile?*
   - Probe: How does it affect day-to-day work or well-being?
3. Improvement – *What practical actions would raise the overall level of leadership in expert firms?*
   - Probe: What would you change first if you had a free hand?
4. Cornerstones – *Which elements are the cornerstones of good leadership?*
   - Probe: Rank the two most critical and explain why.
5. Negative experience – *Have you experienced poor leadership?*
   - Probe: How did it influence your motivation, performance or health?
6. Red lines – *Which leadership practices would you never use yourself?*
   - Probe: What makes them unacceptable?
7. Open floor – *Is there anything else about leadership you wish to add?*
   - Probe: Future trends or generational challenges?

(Each main question maps to COM-B: 1,4 → Capability; 2 → Motivation/Opportunity; 3,6 → Opportunity; 5 → Behaviour outcomes; 7 allows emergent themes.)

3.1 Data Collection and Analysis

The interviews related to the study were conducted in April and May 2024, and the collected data was analysed during the summer of 2024. Eight individuals were selected for the study, each with different levels of experience in leading expert organisations or companies. Six of the interviewees were men and two women. They included CEOs, middle level managers overseeing expert staff, and leaders responsible for business operations and functions. Some also had experience in both leadership and leadership training (see table 1).

Table 1: Interviewee profiles.

Role	Sector	Gender	Years leading
CEO (2)	ICT; Engineering	2 Male	14; 12
Middle Manager	Consulting	2 Male 1 Female	13; 10; 9
Function	Public R&D	1 Male 1 Female	8; 11

The organisations they represented ranged in size from small companies with just a few employees to large corporations employing thousands. The range of experience that was consciously sought in the study enabled a multi-level examination of the focal topic of the study, i.e. leadership in expert organisations and how it is perceived from different positions. The organisations and interviewees were anonymized for the purposes of the study, as some participants requested anonymity to speak openly and candidly without fear of consequences for their careers or current roles. As a result, all interviewees are presented anonymously in the study to ensure fair and respectful treatment of all participants.

The interviews were conducted via remote meetings using MS Teams. The interviews were recorded with the platform's built-in tool, which also provided the first transcription of the video data. There were seven main questions, supported by follow-up and probing questions depending on the flow of each interview and the topics that emerged. Notes taken during the interviews were also used to ensure accuracy and alignment with what was said. The transcribed interviews formed the main empirical data for the study.

The data was categorized thematically using a three-level thematic framework. The themes were based on research questions and divided into two main categories: good leadership and poor leadership. These formed the top level of the framework. Each main theme was further divided into a second level of sub-themes, which refined the overarching categories. The third level consisted of follow-up and probing questions aimed at eliciting concrete and detailed interview responses that would result in rich data, thus allowing for the identification of the key elements of good leadership. Summary statements during the interviews were also applied by the interviewer to help structure and consolidate the themes. If interviewees provided additional comments in response to these statements, their input was categorized under the most appropriate theme.

Data saturation was reached when no new first-order codes emerged in interview 7; interview 8 confirmed stability (Saunders et al., 2018).

3.2 Organisation of Themes

The themes of good leadership support the development of leadership in expert organisations. Interviewees were asked to define good leadership based on their personal experiences, aiming to identify its key components and how it manifests within organisations. Because people perceive leadership differently, the theme was intentionally broad, helping to gather a wide range of elements that contribute to effective leadership.

One theme focused on the benefits and impacts of good leadership. While experiences varied, the significance of these outcomes helped clarify which leadership qualities led to specific positive effecSAts in organisations. Another theme addressed improving leadership in general. This included both enhancing poor leadership and refining already good practices based on lived experiences. Both broad and specific observations were considered valuable in identifying areas for improvement. The fourth theme explored the core principles of good leadership. Interviewees identified the most important building blocks of effective leadership, helping to determine whether a shared understanding of good leadership practices could be formed. The themes on poor leadership focused on participants' experiences and their effects on organisations. Instead of asking for definitions, the study explored poor leadership through concrete observations and personal experiences. The aim was to understand whether interviewees had encountered poor leadership and how it had impacted their work or well-being. A subtheme examined leadership practices the interviewees would avoid entirely, i.e. what they considered unacceptable in leading people or organisations. This helped identify individual boundaries and values in leadership approaches. Follow-up and probing questions were used to explore the main themes and clarify specific points or summarize quotes.

Finally, the categorized interview data was compiled into a unified dataset, organised according to the thematic framework. This synthesis enabled the identification of patterns and recurring elements to support conclusions about the key building blocks of good leadership. The analysis acknowledged that while data within a theme might include multiple viewpoints, all relevant observations were represented. This approach aimed to highlight both commonalities and differences, recognizing that leadership is a wide and interpretative phenomenon that naturally results in different perspectives. (cf. Hirsjärvi and Hurme 2014, pp. 149–150)

The research findings were categorized according to the interview questions into two thematic frameworks: good leadership and poor leadership, with each individual interview forming its own part of the dataset. The data collected from the interviews was processed in such a way that, for each interviewee, the following were identified: a definition of good leadership, the benefits and effects of good leadership, ways to improve leadership, and the cornerstones of good leadership. In addition, the interviews addressed poor leadership through experiences, its effects, and excluded leadership practices. Credibility was reinforced through member checking and multi-author coding discussions, while an audit trail and reflexive journals secure dependability, confirmability and transferability.

4. Findings

The findings of the study are presented in a way that the data from each interviewee was combined according to the main themes. When combining the results, similarities were sought based on how they affect employees in expert organisations as well as, for example, the success of the organisation. To combine the results, key points were listed from each interviewee's data, considering the experiences and observations each interviewee had highlighted regarding the functioning of various expert organisations, their employees, and their leadership. An effort was also made to consider details related to different levels of leadership. These levels were influenced by matters related to the entire company's operational environment as well as matters related to individual employees. Similar items were grouped together to synthesize the results.

The findings reveal that effective leadership in expert organisations is multi-dimensional and closely tied to employee well-being, organisational clarity, and shared values. Good leadership was found to involve future-oriented thinking, organisational resilience, clear communication, strong interaction, and trust. It is characterized by fairness, a supportive work environment, and the ability to empower individuals through consistent and transparent decision-making. Leaders emphasized that when leadership promotes well-being, employees are more engaged, innovative, and productive. The benefits of good leadership include greater organisational success, smoother operations, and improved internal collaboration. Positive leadership practices

were also seen to reduce burnout and improve job satisfaction. Interviewees proposed improvements such as allocating more time for one-on-one leadership interactions, ensuring role clarity, and aligning leadership practices with the real needs of teams. They also stressed the need for leadership development to be intentional and consistent across all organisational levels. The structure of good leadership arising from the data is seen in figure 1.

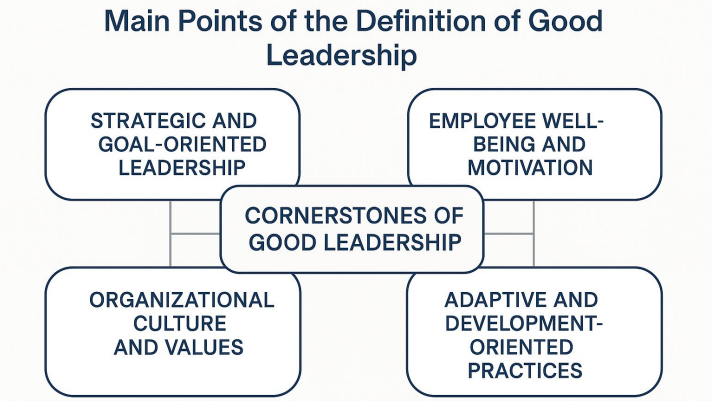


Figure 1: Key elements of good leadership.

The findings show that leadership, good leadership in particular, operates across multiple levels and dimensions. Leadership targets vary: some focus on managing business strategy, vision, and operations, while others focus on leading people, practices, and competencies. Leadership at different organisational levels fulfils distinct roles: top management concentrates on strategic goals, while lower levels lead via people and via daily operations. Effective leadership aligns decision-making with the point of impact, meaning actions are taken at the organisational level where they matter the most. An example of this are decisions concerning individual employees, best managed at the closest possible level to those affected. While leadership occurs across different layers, all levels should align with the same more general, overarching goals.

An important foundation of good leadership is high-quality communication. The findings suggest that Internal communication should be two-way, honest, and transparent. Every employee should have the right and responsibility to voice their views and development ideas without fear of compromising their position. Employees should also have access to private dialogue with their supervisors, including topics or issues that may be unrelated to work. Important in this is that leaders get to know their employees, more specifically their styles, personalities, and responses to situations, and to accordingly demonstrate openness themselves. By setting an example, leaders can maintain a culture where good practices are recognized and further developed (see figure 2).



Figure 2: The benefits and impact of good leadership.

The findings indicate that similar principles apply to decision-making: Employees should be involved in decisions that affect them and be provided with sufficient understanding of the background related to those decisions. Decisions should be made where their impact is felt, and the rationale must be transparent enough to revisit and assess the decision's quality or necessity for revision. Experts can make sound judgments and should be included in the process. Organisations should not adhere rigidly to past decisions and path-dependence but instead reassess their effects as contexts change over time. The result can be a culture in which the organisation voluntarily works toward its goals.

Leadership should also be inspiring and consciously designed to help employees realize their full potential. The role of a leader in this context is not to provide ready-made answers but instead to challenge individuals to find solutions that benefit both the organisation and their own professional growth. When leaders delegate responsibility effectively, they create space for themselves to lead more strategically. For this reason, also, leaders need to cultivate an environment where employees can focus on their core competencies. A leader must stay attuned to the organisation and be able to read signals that point toward success or improvement – and to course-correct if necessary.

The leader's task is to eliminate barriers to productive work and support employees by creating the best possible conditions for success. Leadership also requires giving employees room to work in their own ways. Experts are capable of self-direction, and when they are given the freedom to generate ideas and solve problems independently, it frees the leader to concentrate on strategic oversight. Together, leaders and employees should agree on goals and how to monitor progress. These goals must be clear and realistically achievable within regular working hours to ensure employee productivity, endurance, and well-being. In summary, all aspects of good leadership identified in the study relate to holistic well-being. Poor leadership experiences were clearly linked to decreased well-being and energy. A clear and encouraging environment is important, with equality a key leadership value. The main recommended actions for improving leadership practices in expert organisations, as drawn from the data, are seen in figure 3.

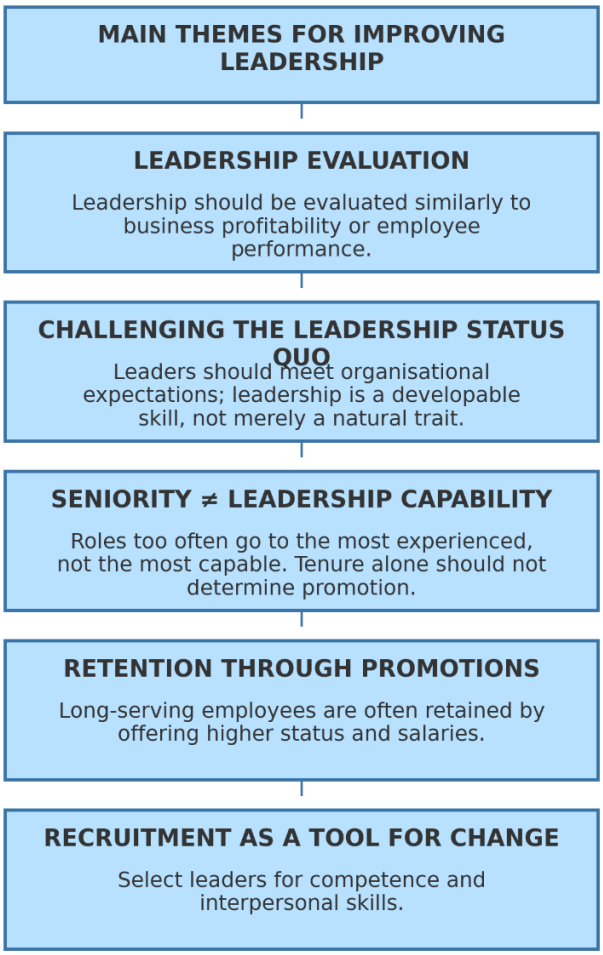


Figure 3: Recommendations for improving leadership practices in expert organisations.

Finally, the synthesis of good leadership in expert organisations, as identified from the empirical analysis, are:

- Empathy and humanity: Leaders should demonstrate empathy, respect and fairness toward all employees.
- Equality and fair treatment: Every individual deserves equal treatment regardless of background, gender or personal traits.
- Lead by example: Leaders should model behaviours that foster a respectful and inclusive culture.
- Moral backbone: Integrity and consistency in behaviour; no double standards or favouritism.
- Challenge hierarchical myths: Experience does not make anyone infallible; questioning a leader's view should be possible.
- Collective problem-solving: Organisations should encourage open discussion and mutual respect to find shared solutions.

5. Discussion

The findings relate closely to ongoing discussions on good leadership in organisations, which appears less a matter of personal charisma and more the systemic alignment of values, communication and decision rights. The prevalence of psychological safety in the findings echoes Edmondson (2019) but positions it as a prerequisite rather than an outcome. We consider that this finding may relate to the specific empirical setting of expert organisations in the present study. The findings revealed that destructive and constructive behaviours can coexist within the same leader, where day-to-day practices and organisational checks can "tip the balance". The five-theme model illustrated in Figure 1 provides a behavioural blueprint that reflects polarised leadership debates in research.

More specifically, by framing leadership as a set of mutually reinforcing practices, it is possible to move the discussion beyond trait-based prescriptions and more towards organisational capability development discussions. In doing so, it becomes possible to construe good leadership practices through a dynamic capability (Teece et al., 1997) framework. These findings also align with recent calls for relational, context-sensitive leadership theory (Foss, Klein & Murtinu, 2022) and demonstrate their applicability in knowledge-intensive economies such as Finland. We next consider how they extend the extant literature, in considering the theoretical contribution of the findings in more detail.

6. Theoretical Contribution

The study contributes to leadership literature by integrating the concepts of destructive leadership and good leadership within expert organisations. In doing so, it provides a structured analysis of how harmful leadership behaviours (e.g., narcissism, manipulation, and disregard for employee well-being) manifest and impact both individuals and organisations. It thus contributes to the ongoing discussion in literature on the nature of good as opposed to poor leadership practices across organisational contexts (e.g., Alexander et al, 2024; Lipman-Blumen, 2005; Acuña and Male, 2022), by categorizing destructive leadership as a multifaceted phenomenon, encompassing both intentional and unintentional behaviours, and by demonstrating how these behaviours can become embedded in organisational culture. Importantly, the findings extend existing literature by linking destructive leadership directly with employee motivation, organisational performance, and cultural toxicity, thereby contributing to a more in-depth, holistic understanding of the dynamics and impact of poor leadership in knowledge-intensive organisational environments.

The developed framework identifying the key cornerstones of good leadership in expert organisations, drawn from analysis of qualitative interviews with leaders across different organisational levels, helps literature on the topic by proposing good leadership as a multi-dimensional construct, encompassing clarity, fairness, well-being, and equality. Unlike many previous models that offer prescriptive leadership styles, this approach emphasizes leadership as a dynamic, context-sensitive process grounded in lived experiences. The resulting guiding principles for leadership development processes, highlighting the notion that leadership is both a cultural and strategic resource for organisational sustainability and employee health.

7. Managerial and Policy Implications

The empirical data also emphasized the need for leadership training that should not be just for leaders, and that organisations should recognize harmful practices and for employees to engage constructively in leadership processes. Future research should aim to create frameworks integrating theory and practice for also improving

leadership and monitoring its development at the organisational level. As Finland faces discussions about shorter workweeks and increasing productivity, good leadership must be recognized as a key driver of organisational innovation and well-being. Another practical implication arising is that leaders should avoid inconsistent or reactive decision-making. Clear direction and fairness are essential and enhancing well-being requires more time spent on leadership, especially in one-on-one interactions. These must be meaningful, uninterrupted, and tailored to the needs of the employees. This is important for managers and leaders to consider, since the findings of this study indicated that many leaders found this aspect especially challenging.

8. Limitations and Future Research

This study had shed light on both destructive and good leadership in expert organisations, highlighting the need for broader research on their effects in the evolving work cultures in national contexts such as in Finland. We also acknowledge several limitations and arising future potential research avenues from the study. One limitation in the present study is that for the time, we did not have a chance for a longitudinal, panel-type data collection. Destructive leadership, though widely recognized in literature, still lacks long-term empirical studies, particularly on how organisational culture either encourages or prevents it (Alexander et al, 2024). The phenomenon is often linked to the individual traits of leaders, yet the role of structural or contextual factors remains underexplored. For instance, placing significant responsibility on a few individuals may inadvertently create conditions for toxic leadership.

Although the five behavioural themes offered here seem to apply across cases, several interviewees warned against over-generalising leadership "cornerstones". Effectiveness ultimately hinges on each organisation's culture, workforce composition and industry context. In the empirical context of our present study, media reports and interviewees included examples where international headquarters imposed aggressive management tactics in Finnish branches, which would suggest a further need for research the keep shedding light on how cultural differences can determine and shape leadership practices.

9. Conclusion

The purpose of this study was to identify the key factors of good leadership in expert organisations and in doing so illustrate how good leadership looks like in expert organisations. While the discussion in academia and in management in practice on what constitutes good leadership and how that can benefit different types of organisations remains ongoing, we see this study as an added contribution to that discussion pertaining to specifics and peculiarities of expert organisations in this research domain. By shedding light on the unique leadership needs and dynamics of expert organisations, this adds to the efforts aimed at explaining the nature and impact of leadership cultures that enhance both employee wellbeing and organisational performance.

Ethics Declaration

No ethical clearance was required for the research.

AI Declaration

AI tool (ChatGPT) was used to re-format the list of references to the correct conference format. Figures 1-4 were translated and re-drawn from the original Finnish data with the help of ChatGPT. Final proof-reading of the manuscript was conducted with Microsoft Office 360 with its Copilot functionality.

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People and Machines or People Against Machines? How Readiness to Artificial Intelligence is Changing Higher Education: A Bibliometric Analysis

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Abstract: AI is rapidly shaping modern higher education in the last 3 years. This paper aims to identify key areas and prospects of readiness to use AI in higher education. The following research question was formulated: What new research directions are observed in the existing discourse on readiness for the spread of artificial intelligence technologies in higher education? To answer the research question, a bibliometric analysis of the joint citations of 2,138 publications indexed in the SCOPUS database for the period 2016-2025 was carried out. Further, within the framework of the study, qualitative coding of annotations was carried out to narrow the sample to 568 of the most significant publications. The analysis identifies five main research areas: (1) the development of strategic readiness for AI within universities, (2) the formation of organizational readiness for AI adoption, (3) the development of consumer readiness among faculty and students, (4) the establishment of psychological parameters of readiness, and (5) the creation of decision-making mechanisms for AI implementation. The integrated implementation of AI in higher education requires information, the development of digital literacy and legal regulation, as well as consideration of social impacts and motivating factors (including hedonism and anthropomorphism) to increase trust in technology. The findings reveal the multi-level nature of AI readiness in higher education, encompassing strategic, organizational, and individual-psychological dimensions. Successful integration of AI depends not only on technological infrastructure and regulatory frameworks but also on users' trust in algorithms, their emotional comfort, and a sense of personal competence. Effective integration is possible only with the coordinated participation of all stakeholders, focused on creating an ethically responsible and technologically advanced educational environment. The presented bibliometric analysis systematizes existing research and highlights new directions in the field of AI application in education. This bibliometric review contributes to an in-depth understanding of the role of artificial intelligence as an important factor in the transformation of higher education and forms the basis for further research directions and practical solutions.

Keywords: Artificial Intelligence, Higher Education, Bibliometric Analysis, Educational Technologies, Strategic Thinking

1. Introduction

Maintaining a competitive position across industries require nowadays organizations to continually adopt innovations (Bagrationi & Gordienko, 2024; Bagrationi & Thurner, 2020, 2023; Diakova et al., 2024; Teece, 2000; Zinchenko et al., 2024). Among these innovations, artificial intelligence (AI) has emerged as a transformative force in the 21st century, widely regarded as a tool for advancing various aspects of modern life (Górriz et al., 2020).

The concept of AI today is often closely associated with its generative form (GenAI), which refers to technologies using deep learning models to produce human-like content, such as text and images, in response to diverse and complex prompts (Choung et al., 2023; Lim et al., 2023; Michel-Villarreal et al., 2023). The launch of ChatGPT triggered a wave of technological breakthroughs across multiple sectors, fueling a surge of academic interest, particularly within higher education (Crompton & Burke, 2018; Nguyen et al., 2023).

Although AI has been actively adopted in universities for over two years, its full potential and impact is highlighted to be underexplored by some higher education professionals (Solís et al., 2023; Zawacki-Richter et al., 2019). Scholars claim that AI presents significant opportunities for both educators and administrators, enhancing instructional quality and streamlining management functions (Gordienko & Bagrationi, 2024; Katsamakas et al., 2024). In the teaching domain, AI promises to enhance learning through personalized education, immediate feedback, and innovative tools like virtual reality and chatbots that boost student engagement and comprehension (Zaman, 2023). From an administrative perspective, AI can optimize processes such as admissions, scholarship allocation, and student profiling, allowing institutional leaders to focus more on strategic quality assurance and less on routine operations (Gordienko & Bagrationi, 2024; Katsamakas et al., 2024).

Recent bibliometric research represents a sharp rise in AI-related publications within higher education segment between 2019 and 2023, underscoring the field's growing interest in adopting these technologies (Zawacki-Richter et al., 2019). In such a rapidly evolving area, it becomes crucial to understand the changing research

landscape. Scholars continue to seek innovative ways to expand existing knowledge, stimulate new lines of inquiry, and engage in critical debates around AI in education (Crompton & Burke, 2018; Crompton & Song, 2021).

However, a crucial determinant of AI's successful integration into educational settings is the readiness to embrace change (Rane et al., 2024). Psychological readiness which us marked by openness to innovation, positive attitudes toward change, and recognition of its value could be a key to driving successful organizational transformation (Bagrationi & Thurner, 2020; Wang et al., 2024).

Given the dynamic growth of this research domain, scholars increasingly call for comprehensive literature reviews to consolidate existing findings on AI readiness within higher education (Zawacki-Richter et al., 2019). Such reviews are essential for mapping intellectual developments, highlighting leading contributors, research institutions, and prominent themes, and identifying emerging trends that shape the field's trajectory (Anand et al., 2021).

Despite an expanding body of work on AI in education, much of the existing literature focuses on isolated aspects, without providing a holistic understanding of how readiness for AI adoption is developing. Recent studies highlight this gap, stressing that the readiness dimension remains insufficiently addressed (Takahashi et al., 2024). Several scholars advocate for a deeper examination of institutional preparedness for AI integration within higher education (Zaman, 2023; Zawacki-Richter et al., 2019).

Bibliometric techniques, especially when combined with science mapping software, offer a robust alternative to traditional narrative and structured reviews. These methods allow for more systematic categorization, conceptual mapping, and trend identification within academic literature (Anand et al., 2021; Anand & Dumazert, 2022). This study employs relational bibliometric approaches (Benckendorff & Zehrer, 2013) to trace theoretical underpinnings (Zupic & Čater, 2015) and uncover emerging research patterns (Walsh & Renaud, 2017).

This research addresses the current gap by systematically examining the scholarly discourse on AI readiness in higher education through bibliometric analysis. Both evaluative and relational methods are utilized to assess the state of research globally, identify leading scholars, the most influential publications, and pinpoint new research trajectories (Walsh & Renaud, 2017)

2. Methodology

To address the gap highlighted within the introduction section, the following research question was formulated:

RQ: What new research directions are emerging in the discourse on readiness for the spread of AI technologies in higher education?

The study proceeded in five stages. First, relevant literature was identified through a structured search in the Scopus database, using keywords related to AI higher education and readiness to change. The search was limited to peer-reviewed journal articles in English, published across the fields of business, economics and sociology. After deduplication in MS Excel, the final dataset comprised 2,138 articles focusing on the readiness of higher education staff for AI integration. Second, science mapping techniques were employed to explore the intellectual structure of the field, following the methods of Anand et al. (2021). Data visualization, including cluster and network maps, was performed using VOSviewer (Van Eck & Waltman, 2010). This step involved analyzing keyword co-occurrence and co-citation patterns to reveal thematic connections across publications. Third, a co-citation analysis (CCA-R) was conducted, building on the framework of Anand & Dumazert (2022). Out of 101439 cited sources, articles cited at least seven times were selected, resulting in a focused set of 568 significant sources. Five major research clusters were identified, each representing key interconnections among authors, topics, and studies. Fourth, qualitative descriptive coding of the abstracts of these 568 articles were performed, following guidelines by Anand et al. (2021) and Salager-Meyer (1990). Two researchers independently coded the abstracts, with a third researcher verifying consistency to ensure reliability and minimize bias. Finally, the data were synthesized using the integrative approach outlined by Schick-Makaroff et al. (2016). This stage focused on consolidating the findings into a coherent overview, providing a structured understanding of the current research landscape regarding AI readiness in higher education.

3. Results

The bibliometric analysis results are represented in the Figure 1.

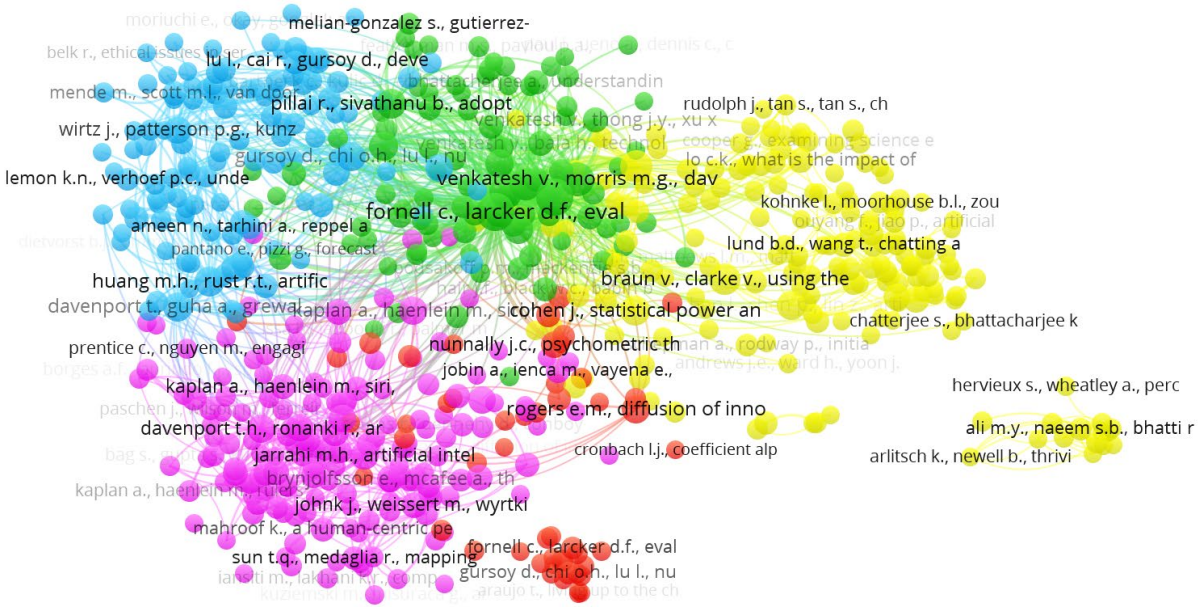


Figure 1: RCC-A results

The yellow cluster, resulting in 168 articles, emphasizes a strong focus on how universities can strategically integrate AI to enhance teaching and learning performance. Key studies within this cluster highlight trends such as chatbot adoption and the rise of generative language models (Chiu et al., 2023; Crompton & Burke, 2023; Crompton & Song, 2021; Zawacki-Richter et al., 2019). Studies highlight trends such as chatbot adoption and the rise of generative language models. Authors like Venkatesh (2022) claim that readiness depends not only on technical infrastructure but also on awareness of AI's potential and limitations (Celik, 2023; Hwang & Chang, 2023). Ethical concerns and privacy issues are also crucial, leading to the development of interdisciplinary AI literacy and ethics courses (Zhang & Aslan, 2021).

The purple cluster, resulting in 148 articles, addresses strategic and organizational factors shaping AI adoption. Scholars within this cluster discuss technological, organizational, and environmental elements ("TOE" framework) influencing digital maturity (Aboelmaged, 2014; Chowdhury et al., 2023; Hradecky et al., 2022). Some scholars underline the need for systematic project management approaches that consider economic, social, ethical, and psychological barriers (Budhwar et al., 2022). Several papers discuss changes in work nature and competencies, drawing on dynamic capabilities theory (Chowdhury et al., 2023; Pan et al., 2023). Other studies note fears of job displacement and resistance (Brougham & Haar, 2018).

The blue cluster, with 105 studies within, examines how users perceive AI in education, emphasizing anthropomorphism, trust, and technology readiness. Research finds that human-like AI features can boost loyalty but may also cause discomfort if overemphasized (Araujo, 2018; Bigman & Gray, 2018; Huang & Rust, 2018). Studies show that perceived usefulness, emotional satisfaction, and ease of use drive adoption (Tung & Au, 2018). Trust plays a crucial role, while algorithm aversion can inhibit engagement unless users can understand or control AI outputs (Dietvorst et al., 2018; Sheehan et al., 2020). The cluster highlights that emotional, ethical, and practical factors jointly shape user acceptance.

The green cluster, consisting of 96 articles, centers on psychological aspects like trust, risk perception, and personal innovativeness. Studies find that perceived ease of use, usefulness, and trust significantly influence satisfaction and continuance intentions to implement AI (Adam et al., 2021). Personal traits such as computer self-efficacy and technology innovativeness positively affect AI acceptance (Balakrishnan et al., 2022; Kasilingam, 2020). Anxiety and fears can hinder adoption (Damerji & Salimi, 2021). Anthropomorphism plays a double-edged role: moderate human-likeness fosters trust, while excessive personalization may lead to discomfort (Cheng et al., 2022). Classical adoption models (TAM, UTAUT, TTF) remain fundamental but must be expanded with constructs like trust, transparency, and emotional comfort (Moussawi et al., 2021).

The red cluster, consisting of 51 articles, explores how AI adoption is framed by decision-making theories (Ajzen, 1991; Rogers & Smith, 1962) and factors like personal innovativeness (Agarwal & Prasad, 1998). Studies show that AI's perceived value and trustworthiness influence its adoption in businesses and educational settings (Chatterjee & Bhattacharjee, 2020). Research also examines AI's role in risk management, highlighting its potential to enhance predictive capabilities (Baryannis et al., 2019). Successful AI integration depends on user experience design and building trust-based interactions (Gursoy et al., 2019; Roy et al., 2022)

4. Discussion

The findings highlight the need for university leadership and policymakers to proactively support AI adoption. The analysis of publication venues showed that journals like Sustainability and IEEE Access are prominent in disseminating AI-in-education research. This prominence suggests a convergence of interests between educational innovation, sustainable development, and technological advancement. University administrators should interpret this as a mandate to embed AI into strategic planning in a way that supports sustainable education goals and technical excellence. Administrative readiness involves establishing clear policies, ethical guidelines, and support structures for AI use on campus.

According to the Unified Theory of Acceptance and Use of Technology (UTAUT), performance expectancy (belief that using AI will improve outcomes) and effort expectancy (perceived ease of use) are primary drivers of technology adoption, along with social influence (peer and societal encouragement) and facilitating conditions (availability of support and resources) (Venkatesh, 2022). Our analysis found corroborating evidence: across many studies, the anticipated benefits of AI (e.g., enhanced learning personalization, efficiency in grading or administrative tasks) and the perceived ease of using AI tools emerged as significant predictors of stakeholders' intention to use AI (Balakrishnan et al., 2022).

Situating findings within established frameworks provides deeper insight. The patterns observed resonate with the UTAUT model, which integrates elements from earlier models (including TAM) and emphasizes that technology uptake results from a mix of expected performance gains, user-friendliness, social norms, and organizational supports. Our findings that performance expectancy and ease of use are crucial confirm the applicability of UTAUT in the AI-in-education context. Moreover, the identification of hedonic motivation as a factor suggests that many users engage with AI not just out of necessity but also curiosity or enjoyment, an extension captured by UTAUT2 (García de Blanes Sebastián et al., 2022). On the other hand, the noted barriers (distrust, lack of knowledge) point to additional theoretical considerations (Chatterjee et al., 2021). The TOE framework posits that successful adoption depends on technological factors (e.g., maturity and fit of AI tools), organizational factors (e.g., leadership, culture, internal processes), and environmental factors (e.g., policy, market, social pressures). In our context, an institution with robust IT infrastructure and tech support (technology), visionary leadership and agile governance (organization), and a favourable external environment such as government incentives or clear regulations (environment) is far more likely to be ready for AI integration. Indeed, recent analysis emphasizes that technology–organization–environment synergy is needed: technology should match user demands, organizations must optimize decision-making and support, and the broader environment should provide enabling policies (Bigman & Gray, 2018; Choi et al., 2022).

While existing studies within each identified cluster provide valuable insights into specific dimensions of AI readiness in higher education, our bibliometric synthesis reveals several intersections and silences across these domains that have not been adequately addressed in prior work, especially within the lens of institutional theory (DiMaggio & Powell, 1983; Scott, 2013). Although, organizational and psychological readiness and are extensively discussed (e.g., clusters 2 and 4), few studies (e.g. Rudko et al. (2025)) systematically examine institutional configurations that balance individual perceptions and behaviours in practice. This fragmentation creates a blind spot in understanding how readiness is shaped by different levels of decision making within the organizations.

Another topic narrowly discussed within the existing literature is the role of government initiatives, that could vary across different cultures (Chatterjee & Bhattacharjee, 2020; Zawacki-Richter et al., 2019). This issue surfaced in several abstracts but was not thematized in prior systematic reviews, indicating a potential research opportunity.

5. Conclusion

The findings underscore the societal and educational importance of proactively preparing higher education institutions for AI integration. Higher education sits at the nexus of knowledge creation and human capital development, and as such, it plays a pivotal role in how society adapts to the AI revolution. Our analysis resonates with global viewpoints that universities are crucial in shaping and advancing national AI strategies by driving innovation, developing an AI-skilled workforce, and modelling ethical technology use. Indeed, as educators and researchers, universities are responsible for training the next generation of citizens and professionals to thrive in an AI-augmented world. By ensuring that higher education is ready for AI – through updated curricula that include AI literacy, investments in cutting-edge educational technologies, and policies that safeguard ethical practices – we are in effect safeguarding the future competitiveness and well-being of society. Preparing institutions for AI integration means that students will graduate with relevant skills for the future economy, and that academic research can continue to push the frontiers of what AI can do for human learning and development. In a broader sense, university readiness for AI contributes to society by promoting informed and ethical AI use beyond campus, as graduates carry those values and practices into their communities and workplaces.

This study also emphasizes that the integration of AI in higher education is not purely a technical endeavour, but a transformative educational mission. We highlighted how AI has the potential to offer personalized learning experiences, more efficient administrative services, and data-informed decision-making in academia. These opportunities, if effectively harnessed, could foster deeper student engagement and improve educational outcomes, helping institutions better fulfil their pedagogical missions. However, realizing this potential requires careful readiness and change management. Our conclusions stress that preparing for AI involves cultivating a supportive institutional culture and strong ethical governance. As such, one of the key contributions of our work is drawing attention to the human-centric and ethical dimensions of AI readiness. We have shown that issues of trust, equity, and inclusivity are intertwined with technical readiness. A major societal implication of these findings is the need to ensure that AI integration in education enhances equity and access rather than exacerbating divides. If only elite universities or certain countries lead in AI-readiness, we risk creating a new digital divide in which some graduates are AI-proficient, and others are left behind. Therefore, the importance of widespread readiness is both an educational and a social imperative – it speaks to the role of higher education in fostering an inclusive knowledge society where AI benefits all.

6. Future Research Directions

Future studies should track the evolution of AI adoption and impacts in universities over time. Long-term research could examine how initial readiness (in infrastructure, policy, and culture) influences outcomes such as student performance, faculty workload, or institutional efficiency after several years of AI integration. Such longitudinal data would help distinguish short-term novelty effects from sustainable improvements, and reveal how acceptance factors (e.g., trust or perceived usefulness) change as users become more familiar with AI. Research should also delve deeper into how AI readiness and adoption differ across disciplines and institution types. Also, studies on AI in higher education should focus on uncover context-specific barriers and enablers. Understanding these nuances will guide more tailored readiness strategies. Given the importance of administrative readiness, further research is needed on organizational change models and policy frameworks that facilitate AI integration in the universities.

Ethics Declaration

This study did not involve human participants, personal data collection, or experimental interventions and therefore did not require ethical clearance.

AI Declaration

During the preparation of this paper, AI tools (specifically, ChatGPT o1 by OpenAI) were used to assist in language editing and improving the clarity and fluency of the text. The content generated by the AI was critically reviewed, edited, and integrated by the authors to ensure accuracy, originality, and academic integrity.

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A Study on Unified Payment System and its Role in the Growth of Fintech Sector in India

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Abstract: The study aims to identify the potential of United Payment System (UPI) as common interface for consumer payment solutions in India. India is one of the fastest-growing Fin-Tech marketplaces in the world. India is currently ranked fourth in terms of total fintech funding. A number of important elements contribute to India's status as a hub for the growth of fintech sector. The fintech market in India is expected to grow at a compound annual growth rate (CAGR) of 32.7%, from a value of US$106.2 billion in 2024 to US$769.5 billion by the end of 2031. By 2025, the worldwide fintech market is expected to be worth $306 billion. With an impressive 14% of worldwide investment, India's FinTech industry is a major player on the international scene. The FinTech Market Opportunity is expected to reach an astounding $2.1 trillion by 2030, and the nation ranks second in terms of deal volume. The methods we use as customers to access our bank accounts, make purchases, and obtain loans are all undergoing significant change. In an effort to anticipate consumer demands, cater to existing clients, and stop fraud, financial institutions are also continuously changing and adopting UPI as most widely acceptable payment gateway.

Keywords: Fintech, Financial Inclusion, Partner Applications, Digital Payment Systems, United Payment Interface

1. Introduction

India's vision directed to an organized financial ecosystem is essential towards achieving the country's goal of being a developed nation by 2047. India is now a more financially inclusive nation due to the tremendous growth of digital payments. India's reliance on cash is declining as the use of digital payments are increasing. In recent years, India has emerged as a pioneer in digital payments thanks to the development of an environment that facilitates the adoption and usage of these payment methods. UPI, handles more than 75% of retail digital payments in India, is still leading this growth story. By eliminating the difficulties associated with cash transactions, digital payments are promoting the expansion of new industry sectors (both B2B and B2C). In India, digital payments are being commonly adopted from a small kirana shop to a big merchant establishments managing complex payments. They are developing solutions to better safeguard customers against fraud and money laundering with the aid of artificial intelligence (AI) and machine learning (ML).

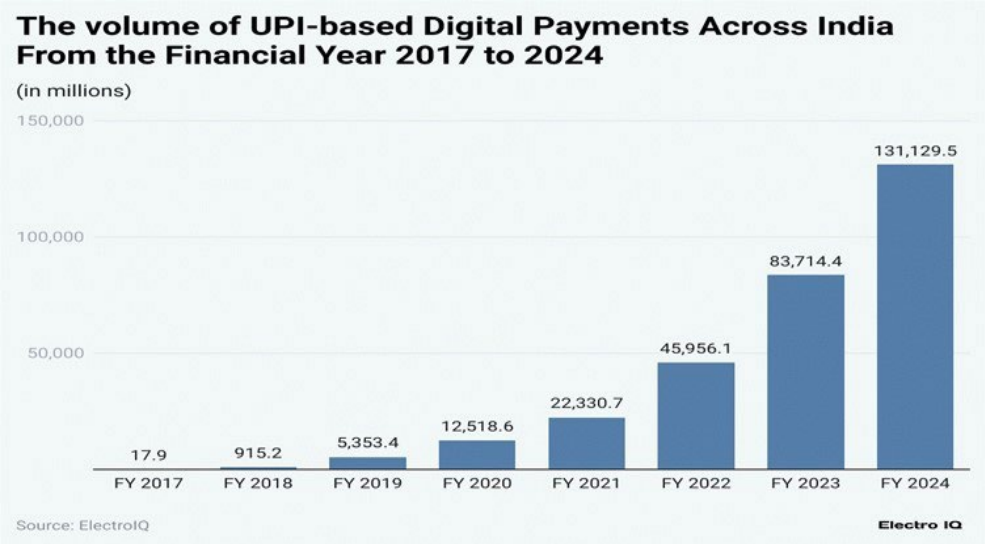


Figure 1: Volume of UPI- based Digital Payments from 2017-24 in India

Source Statista 2024

According to UPI statistics, the number of UPI payments made in India has been steadily rising. By the end of 2023, the transaction volume had grown from 17.9 million in 2017 to 83714.4 million. The number of transactions is expected to reach 131,129.5 million by the end of 2024. Approximately 147 million households

also lacked access to any kind of banking. Addressing corruption and black money, which primarily occurred in cash, was another issue. In 2014, the RBI published a four-year vision statement outlining its commitment to creating an authorized, safe, accessible, and inclusive payment and settlement system in India. The RBI has expressed its intention to regulate the FinTech sector and take a more targeted approach in order to support and expand the business in India. In October 2024, UPI handled 16.58 billion financial transactions totaling ₹23.49 lakh crores, a 45% increase from the 11.40 billion transactions in October 2023. This increase in usage, which has 632 banks linked to its platform, demonstrates UPI's growing monopoly in India's payment market. The National Payment Corporation of India (NPCI) was established in April 2009 with the goal of standardizing and integrating all of India's payment methods for retail transactions. The Green Initiative, which aimed to reduce the amount of paper used in domestic payments. UPI was formally introduced to the general public of India in 2016.

2. Literature Review

The advent of United Payment System has revolutionized the rural and urban financial landscape by enhancing the efficiency thereby disrupting traditional banking models in India. Unified Payment System (UPS) acts as the backbone for various fintech innovations. This literature review synthesizes existing research on the role of UPS in the growth of the fintech sector across different regions, highlighting key findings, knowledge gaps, and potential future research directions. A unified payment system serves as a crucial infrastructure that enables seamless transactions across diverse financial services. The volume and value of UPI transactions in rural areas rose by 118% and 106%, respectively in 2023-24. This increase is a result of Tier-II cities moving toward digital payments for services including assisted commerce, insurance, and utility payments. The automation of payment processes through UPS can lead to cost-effective solutions that is essential for fintech growth. While some argue Fintech completely disrupts traditional banks, others see opportunities for collaboration through hybrid models (Arner et al., 2020). The integration of various payment methods—including cryptocurrencies—through UPS enhances user experience and trust, which is critical for the sector's expansion (Ducas & Wilner, 2017). Furthermore, the ability of UPS to streamline payment processes is vital for enhancing the efficiency of credit supply and payment services (Agarwal & Zhang, 2020). Several studies emphasize the potential of UPS to promote financial inclusion, particularly for small and medium enterprises (SMEs) and low-income households including rural areas. In China, for instance, a standardized platform offered by UPS enables easier access to financial services, addressing regulatory uncertainties while fostering innovation (Hua & Huang, 2020). Similarly, in emerging markets, UPS can enhance the adoption of e-wallets by providing consistent and secure transaction platform thus supporting economic development (Tian et al., 2023).

The growth of Fintech is rooted in digitalization and disruptive technologies (Arner et al., 2020). Early literature focuses on the transition from traditional banking to technology-driven platforms, highlighting innovations such as digital wallets (PayPal, Venmo), blockchain-enabled transactions, and peer-to-peer (P2P) systems (Gomber et al., 2017). Unified payment systems are seen as the latest innovation in this context, integrating multiple payment channels (mobile apps, QR codes, NFC) into one cohesive ecosystem (Maurya et al., 2022). Unified payment systems rely on technologies like Artificial Intelligence (AI), blockchain, and Application Programming Interfaces (APIs). Studies emphasize how APIs allow interoperability and seamless integration across service providers supporting financial inclusion (Chen et al., 2019). Blockchain technology, often linked with cryptocurrency, offers secure, efficient, and transparent solutions for unified systems (Wamba et al., 2020). Literature review also emphasizes AI's role in fraud detection and user personalization within payment systems (Kou et al., 2021). The success of unified payment systems depends largely on user adoption in Tier 1, Tier 2 and Tier 3 cities largely influenced by ease of use, trust, security, accessibility and perceived usefulness (Venkatesh et al., 2003).

Researchers have examined customer segmentation and demographic influences, identifying digital literacy as a key barrier in developing economies (Maurya et al., 2022). However, there is limited research on behavioral economics and cultural influences in this domain.

3. Methodology

Exploratory research methodology have been used to conduct secondary data analysis of the existing literature and data collection from various government websites to assess and evaluate the growing success of UPI in India.

4. Results and Discussion

4.1 UPI Version 2.0 in India: Transforming the Fintech Sector landscape

By the end of 2024, it is anticipated that there will be over 367 million UPI users, highlighting the growing acceptance of UPI as a preferred payment method.

Table 1: India Payment System Indicators December 2024

Financial Market Infrastructures (FMIs)			
Settlement Systems	**FY 2023-24**	**November 2024**	**December 2024**
1 Credit Transfers - RTGS	**170886670**	**14826882**	**19163587**
1.1 Customer Transactions	152406168	13504833	17161423
1.2 Interbank Transactions	18480503	1322050	2002163
II Retail			
2 Credit Transfers - Retail	**67542859**	**6274182**	**6935632**
2.1 AePS (Fund Transfers) @	261	14	17
2.2 APBS $	390743	32384	58705
2.3 IMPS	6495652	558328	601549
2.4 NACH Cr $	1525104	147385	135695
2.5 NEFT	39136014	3380884	3814966
2.6 UPI @	19995086	2155187	2324700
2.6.1 of which USSD	352	16	16
3 Debit Transfers and Direct Debits	**1687658**	**185643**	**198303**
3.1 BHIM Aadhaar Pay @	6112	629	547
3.2 NACH Dr $	1678769	184814	197549
3.3 NETC (linked to bank account) @	2777	200	207
4 Card Payments	**2423563**	**208387**	**228757**
4.1 Credit Cards	**1831134**	**169298**	**188086**
4.1.1 PoS based $	651911	68233	73185
4.1.2 Others $	1179223	101065	114901
4.2 Debit Cards	**592429**	**39089**	**40671**
4.2.1 PoS based $	393589	26756	27681
4.2.2 Others $	198840	12333	12990
5 Prepaid Payment Instruments	**283048**	**19214**	**18992**
5.1 Wallets	234353	13130	14437
5.2 Cards	**48695**	**6083**	**4556**
5.2.1 PoS based $	11247	915	991
5.2.2 Others $	37447	5168	3565
6 Paper-based Instruments	**7212333**	**537849**	**587879**
6.1 CTS (NPCI Managed)	7212333	537849	587879
6.2 Others	0.00	0.00	0.00
Total Retail Payments (2+3+4+5+6)	**79149461**	**7225275**	**7969563**
Total Payments (1+2+3+4+5+6)	**250036131**	**22052158**	**27133149**
Total Digital Payments (1+2+3+4+5)	**242823799**	**21514309**	**26545270**

Source RBI: https://www.rbi.org.in/Scripts/PSIUserView.aspx?Id=21

As per the table above the total Digital payments increased from INR 21514309 in November 2024 to INR 26545270 in December 2024 with almost an increase of 123% which is remarkable. By December 2024, it is estimated that there will be 465 million UPI transactions per day. In 2016, instant payment system known as Unified Payments Interface (UPI) was developed by the National Payments Corporation of India. This facilitates inter-bank peer-to-peer (P2P) and person-to-merchant transactions.

Both person-to-merchant and interbank peer-to-peer (P2P) transactions are made easier by this technology. It is used to instantly move money between two bank accounts on mobile devices. With the RBI's Digital Payments Index (RBI-DPI) increasing by 4.45% from March 2024 to 465.33 by September, India's digital payment system demonstrated significant progress in 2024. The Unified Payments Interface, or UPI, maintained its hegemony with a 32% increase in transaction value and a 45% increase in transactions from 2016 to 2024.

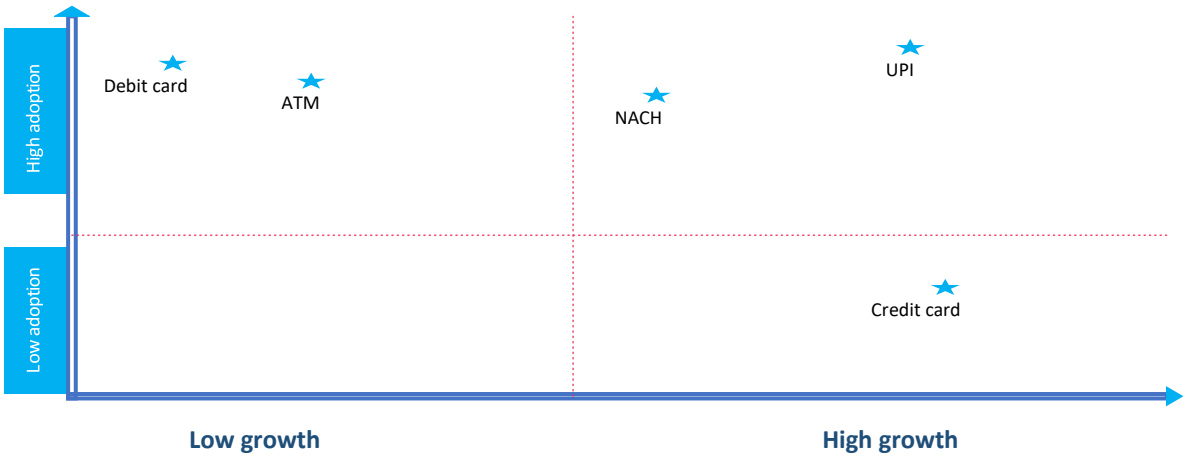


Figure 2: Mapping payment instruments for growth and adoption rate in India

Source: PwC.in

As per the above graph, UPI shows both high growth potential and high rate of adoption in India in comparison to other financial instruments like credit cards, debit cards, NACH, and use of ATMs'. With UPI accounting for 48% of all immediate payment transactions globally in 2022-23, India remains the global leader in rapid payments making up 48% of all instantaneous payments worldwide. In India, the site boasted over 300 million monthly active users as of November 2022.

With a 60% increase in transaction volume and a 47% increase in transaction value over 2022, the total annual value of UPI transactions in India in 2023 rose to ₹183 lakh crore, or $2.3 trillion. In 2023, the RBI governor introduced the UPI 123PAY service, which aims to assist the nation's almost 400 million feature phone customers. Up until recently, smartphone payment apps were the only way to make UPI payments. FASTag recharges, insurance payments, and EMI collections are a few of the early use cases, according to NPCI.

According to the Reserve Bank of India's (RBI) Payments System Report, the United Payments Interface (UPI) has become the most important platform in India's digital payments ecosystem, accounting for 81% of all payments by the end of 2024, up from 34% in 2019. At the same time, the proportion of alternative payment methods, such as card-based payments, National Electronic Funds Transfer (NEFT), Immediate Payment Service (IMPS), and Real-Time Gross Settlement (RTGS), decreased to just 19%. By 2024, UPI's transaction volume had increased from 375 crore in 2018 to 17,221 crore, and the overall volume of digital payments had reached 20,787 crore.

Table 2: Comparison of UPI Payment Partners from 2016 to 2024

Year	No. of Payment Partners on UPI	Transaction volume (in mn)	INR value (in mn)	USD value (in bn)
2024	634	139,995.97	202,026,334	2,393.32
2023	523	117,675.99	182,844,068.2	2,195.03
2022	384	74,044.48	125,948,187.3	1,699.71
2021	285	38,744.55	71,592,858.0	966.17

Year	No. of Payment Partners on UPI	Transaction volume (in mn)	INR value (in mn)	USD value (in bn)
2020	200	18,880.89	33,877,447.2	457.19
2019	142	10,787.54	18,366,381.8	247.86
2018	128	3,746	5,857,104.5	79.04
2017	65	418	570,208.7	7.7
2016	32	2.65	8,930.7	0.12

Source NPCI portal

As evident from the Table 2 above comparing UPI transaction payment between the period from 2016 to 2024. UPI payments partners increased tremendously from only 32 in 2016 to 634 payment partners in 2024 enhancing financial inclusion and economic growth. Similarly, transaction volume increased from 2.65 million having INR value of 8930.7 million to 418 mn in 2017 to 139,995.97 mn in 2024 with INR value 202,026,334 mn in 2024 highlighting the transformative impact in India's financial landscape.

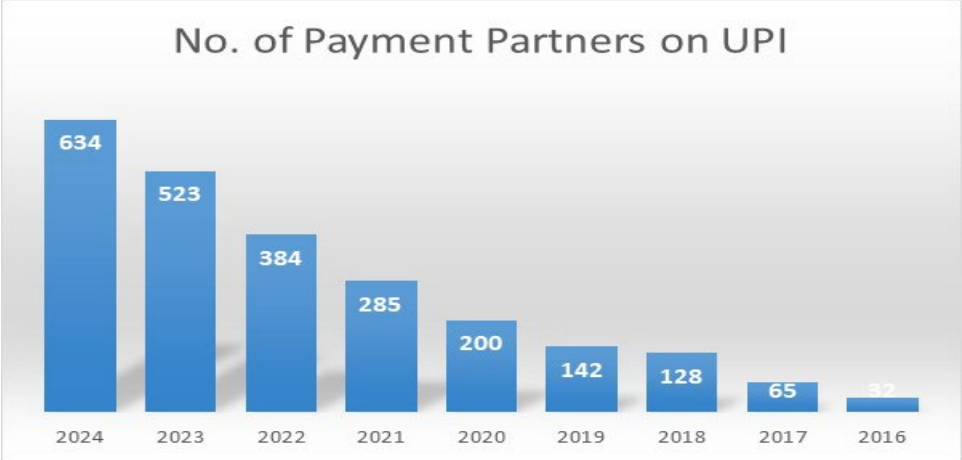


Figure 3: Increase in Fintech Payment using UPI since 2016-2024

Source NCPI Portal

The graph above shows the growing potential of Fintech Sector related to digital payment using UPI in India from 32 payment partners to 634 in the last nine years. Digital payments have increased significantly in fintech sector especially in recent years with increased acceptance of cashless payments/ transactions. Significant increases in digital payment volumes, greater financial inclusion, and expansion of digital payment acceptance locations including rural areas have all contributed to the growing success of cashless payments in India. In the FY 2022–2023, digital payments in India maintained a robust YoY growth rate of 58.5%. India also intends to establish emergency payment systems like a lightweight payment and settlement system (LPSS) and has made investments in contemporary payment systems like Central Bank Digital Currency (CBDC). India's digital payments sector is expanding, but it also confronts obstacles like rising fraud rates, restricted access to clients in rural areas, pressure on stakeholder profitability, and the need to raise consumer knowledge.

Table 3: UPI Application Based Market Share 2024 in Fintech Sector in India

Market Share by Applications-2024						
Application	Transaction Volume (Mn)	Rank (Volume)	% Volume	Transaction Value (₹ Mn)	% Value	Rank (Value)
PhonePe	6500.14	1	48.86%	10016796.3	51.00%	1
Google Pay	5027.32	2	37.79%	6941896.8	35.34%	2
Paytm	1117.13	3	8.40%	1225542.5	6.24%	3
Cred	138.46	4	1.04%	432332.1	2.20%	4
Axis Bank Apps	69.80	5	0.52%	64832.4	0.33%	8
Amazon Pay	64.33	6	0.48%	67848.2	0.35%	7

Market Share by Applications-2024						
Application	Transaction Volume (Mn)	Rank (Volume)	% Volume	Transaction Value (₹ Mn)	% Value	Rank (Value)
ICICI Bank Apps	47.41	7	0.36%	266388.8	1.36%	5
FamApp	46.64	8	0.35%	5880.0	0.03%	10
Kotak Mahindra Bank Apps	41.54	9	0.31%	61018.8	0.31%	9
HDFC Bank Apps	35.99	10	0.27%	76897.6	0.39%	6
Others	215.75	–	1.62%	480980.0	2.45%	–
Total	13304.51	–	100.00%	19640413.5	100.00%	–

Source NCPI Portal

As per Table 3 above it can be established that PhonePe recorded highest transaction volume of 48% ranked first followed by google pay at 37%. These two apps capture almost 86% of the total market share of UPI transactions followed by Paytm. The other transaction platforms such as cred, axis bank, amazon pay, icici bank, kotak, and others have only 14% of the total market share. UPI has successfully generated 940 million transactions totaling ₹1450 billion up from 94,000 transactions by 2020 valued at ₹35 million. UPI also reported 7.66 million IPO mandates in 2020-21. This was the highest since the Securities and Exchange Board of India mandated that domestic retail investors use UPI for the IPO process. 17% of India's GDP was transferred via UPI transaction. With the highest average daily transaction of about 150 million, UPI recorded 435 million transactions, accounting for ₹577,356 million, which is double the amount from 2020. UPI grew at a 147% CAGR. The value of UPI transactions rose from ₹1 lakh crore in FY 2017–18 to ₹139 lakh crore in FY 2022–23 at a compound annual growth rate (CAGR) of 168%. UPI has been the main force behind the growth of digital payment transactions in India overall, accounting for 62% of all transactions in FY 2022–2023.

4.2 UPI Fintech Internationalization Initiatives in India

In 2021, almost 700 million Indian shoppers crossed the border. On November 17, 2021, NPCI International Payments Limited (NIPL) and UK-based PPRO Financial signed a memorandum of understanding (MoU) to increase the acceptance of UPI in international markets, particularly those in China and the US, which account for half of all international transactions originating from India. This was done to facilitate payments. Transact365, a fintech startup located in the UK, enabled UPI for international merchants on January 26, 2022, providing real-time currency conversion capabilities that will enable them to conduct business in India without the need for local presence. In accordance with bilateral treaties, the RBI will work to internationalize UPI with countries that use the US currency, the pound sterling, and the euro after releasing the Payments Vision 2025.

Table 4: List of countries that accept UPI

List of Countries That Accept UPI		
India	Singapore	South Korea
Armenia	Thailand	Bahrain
Bhutan	Cambodia	Maldives
Nepal	Vietnam	United Arab Emirates
France	Sri Lanka	Australia
Qatar	Indonesia	Japan
Saudi Arabia	Oman	Switzerland
Malaysia	Mauritius	Russia
United Kingdom	European Union	Canada

Source NCPI.

Around 27 countries are accepting UPI as listed in the Table 4 above. In 2023-24, PhonePe declared that it would be expanding UPI's capability for international payments in the United Arab Emirates, Singapore, Mauritius, Nepal, and Bhutan. From Indian bank accounts, users would be able to make direct payments in foreign

currencies. NIPL and PPRO Financial inked a final agreement that will allow international merchant acquirers and payment service providers (PSPs) to accept UPI. Additionally, it aims to expedite international remittances by utilizing the UPI infrastructure. Users of Apple iPhones, iPads, and iPod Touches in India will also be able to use UPI. The UPI AutoPay option, which was previously restricted to credit and debit cards from Visa, Mastercard was added by Netflix for Indian users. Hotstar began to implement the UPI AutoPay service in August 2021. Jio launched UPI AutoPay for postpaid and prepaid mobile users. Tata Mutual Fund with CAMSPay implemented the Systematic Investment Plan (SIP) with UPI AutoPay capability. Zomato and Swiggy introduced their own UPI to streamline the checkout process, minimize unsuccessful payments, and lessen dependency on third-party apps.

5. Conclusion

India remains the global leader in Fintech digital payments making up to 48% of all instantaneous payments worldwide. With the growing acceptance of UPI as preferred payment method more and more customers and businesses in India are adopting UPI as the safer alternative for doing cashless (online) transactions. From 92 crore in FY 2018 to 8,375 crore in FY 2022–2023, UPI grew at almost 147% CAGR. Also, more than 75% of retail digital payments including rural areas are done via UPI creating a huge scope for growth of Fintech sector in India enabling financial inclusion and economic development. UPI has become a powerful instrument for India as a result of its growing success. It an example of India's most prosperous deep-tech financial innovation till date. Approximately 75% of UPI users currently come from non-Tier-1 cities. Additionally, Tier-2 cities including rural areas account for more than 80% of newly enrolled users. The ability to view and save an invoice for every transaction was also provided in UPI.

Despite the promising findings regarding UPS's role in fintech growth, several knowledge gaps exists. First, there is a need for comprehensive studies examining consumer behavior in relation to UPI adoption across different demographics and regions. Understanding the factors that influence user trust and perceived risks can help tailor UPS implementations to diverse markets. Second, the impact of UPI on specific fintech services, such as lending and investment, remains underexplored. Future research could investigate how UPS facilitates interactions between fintech companies and traditional banks, particularly in terms of collaboration and competition. Lastly, the long-term implications of UPI on financial stability and economic growth require more rigorous examination. As fintech continues to evolve, understanding the role of UPS in fostering innovation while maintaining stability will be essential for policymakers and stakeholders in the financial sector. The Unified Payment System is a pivotal element in the growth of the fintech sector, facilitating efficiency, financial inclusion, and regulatory compliance. Foreign visitors to India may now use the UPI Wallet feature, which allows them to add money using their preferred debit or credit card and begin scanning their purchases at more than 20 million Indian stores without incurring commission fees. Due to the wallet's widespread acceptability, customers may easily transact anywhere both nationally and internationally.

Ethics Declaration

This research does not need ethical clearance for the research.

AI Declaration

I have not used any AI tool for writing this research paper. This is my original research.

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Benefits and Importance of Digital Technologies as Digital Maturity Drivers: A Case Study of Finland

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Abstract: This research explores the factors driving digitalization in Finnish SMEs and contributes to the discussion on Digital Maturity Models (DMMs). It examines how perceived benefits and the importance of digital technologies influence SMEs' digital capabilities. By identifying key motivators and barriers, the study aims to provide practical insights for both academics and practitioners, bridging the gap between theoretical models and real-world applications. A stratified sample of 1002 Finnish SMEs is used. K-means clustering categorizes these companies into three distinct clusters based on their digital maturity levels. Logistic regression models predict the likelihood of a company belonging to each cluster, using perceived benefits and the importance of digital technologies as predictor variables. This approach systematically analyzes the relationship between these factors and digital maturity, offering a robust framework for understanding digitalization in SMEs. Additional analyses explore interaction effects between predictor variables, providing deeper insights into the dynamics of digital transformation. The study yields six logistic regression models with 19 statistically significant coefficients ($p<0.05$). Results indicate that perceived benefits and the importance of digitalization vary across clusters, highlighting different motivators for digital initiatives based on digital maturity levels. SMEs with higher digital maturity perceive greater benefits and place higher importance on different digital technologies compared to those with lower maturity. These findings emphasize the need for tailored strategies to support digitalization efforts and reveal significant variations in the adoption of specific technologies at different stages of digital maturity. The findings guide practitioners and academics in focusing on relevant technologies and their outcomes concerning SMEs' digital maturity. Targeted interventions and support mechanisms should address the specific needs of SMEs at various stages of digital maturity. The study contributes to the evolution of DMMs by providing empirical evidence on the factors driving digitalization in SMEs and underscores the importance of a phased approach to digital transformation. Future research should include cross-country comparisons and longitudinal studies to enhance the reliability and validity of the results and understand the temporal aspects of digital transformation.

Keywords: Digital Maturity Models, SME, Digital Transformation

1. Introduction

The digital revolution has been affecting companies in all shapes and sizes, starting from converting analog material into digital form (Xie and Matusiak 2016, p. 59) continued by implementing plans for user access and information reuse (Brown 2013, p. 20–21) in a business setting. This process – dubbed “digitalization” – is a prerequisite for a company’s digital transformation. Transitioning from isolated digital processes, digital transformation can be understood as an overarching influence on the entire organizational process. Lucas et al (2013) describe "digital transformation" as a phenomenon that drives multifaceted individual, firm, and even societal changes. Fitzgerald et al (2014) and Verhoef et al (2021) further highlight the strategic nature of digital transformation, asserting that it should facilitate significant business advancements. Additionally, Urbinati et al (2020) note that digital transformation and its associated technologies significantly impact the capture and dissemination of knowledge, enhancing not only operational efficiency but also innovation and value co-creation processes (see e.g. Klingenberg et al 2022; Balta et al 2021; Lähteenmäki, Nätti and Saraniemi 2022; Barykin et al 2022). By adopting digital technologies, even “traditional” non-digital industries can optimize their processes, automate tasks, and reduce manual errors, leading to increased productivity and cost savings (Chowdhury, Adafin and Wilkinson 2019). Consequently, digital transformation should be perceived not merely as a collection of new technologies but through a comprehensive, holistic lens.

Digitalization poses numerous challenges for Small and Medium-Sized Enterprises (SMEs), impacting their ability to innovate and grow economically. One significant challenge is the financial burden associated with adopting digital technologies. High investment costs and limited financial resources often hinder SMEs from fully embracing digitalization (Restrepo-Morales et al 2024; Hassan et al 2023). In addition to individual upfront costs for digitalization, the economic and governmental circumstances can affect the SME digitalization initiative, favoring regions where general governmental support systems for R&D investments are higher (Brodny and Tutak 2022). Moreover, the digital transformation of a company is a strategic-level decision encompassing all aspects of a business (Henderson and Venkatraman 1993; Verhoef 2021) making the case for having a well-qualified staff in transforming IT into a profit-generating mechanism on a business level as opposed to only a functional level (Drnevitch and Cronson 2013). On that note, SMEs frequently struggle to find and retain

employees with the necessary digital skills, which can impede the effective implementation of digital technologies (Rivza et al 2019; Rupeika-Apoga and Petrovska 2022). This skills gap is further exacerbated by resistance from workers who may be reluctant to adapt to new digital processes (Restrepo-Morales et al 2024). The nature of these skills gaps can be examined by using the absorptive capacity of SMEs, or their ability to recognize, assimilate, and apply new knowledge, as it plays a crucial role in their digital transformation (Cohen and Levinthal 1990; Zahra and George 2002; Todorova and Durisin 2007 and Coccia 2007). SMEs with higher absorptive capacity are better positioned to leverage digital technologies for innovation. However, many SMEs lack this capacity, which can stifle their innovation performance and overall competitiveness (Hassan et al 2023).

In the wake of the digital revolution, SMEs are increasingly tempted to utilize data-driven technologies and automation to increase their competitiveness. The Internet of Things (IoT) technologies and data-driven solutions enable companies to use e.g., context-based adaptive systems, robust scheduling, and a fusion of real-world and virtual design and manufacturing systems as well as customer touchpoints for a more immersive customer experience (Monostori et at 2016). Understandably, the successful interplay between such technologies is a complex scenario, requiring competence and self-assessment on multiple levels (Atzori et al 2010; Schuch et al 2014 and Li, Xu and Zhao 2015).

To ease companies into their digital transformation processes, a number of various Digital Maturity Models (DMMs) have been developed to help companies self-evaluate their digital potential. These DMMs are structured frameworks designed to assess an organization's readiness and capability to adopt digital technologies and practices, providing a systematic approach to evaluate the current state of digitalization within an organization and identifying strengths, weaknesses, and areas for improvement. By offering a clear pathway for digital transformation, the models assist organizations in navigating the complexities of integrating digital technologies into their operations and strategies, as well as integrating digital transformation methodologies into their culture (Ganzrain and Errasti 2016). There are numerous DMMs available, and the majority of them are tailored toward certain industries or offering various focus points regarding the drivers, dimensions, or types of digitalization (see eg. Zamora Iribarren et al 2024; Sassanelli et al 2022; Cognet et al 2020). Brodny and Tutak (2022) have conducted a comprehensive analysis of the most common DMMs, including the following models:

- A maturity model for Industry 4.0 Readiness
- The Degree of readiness for the implementation of Industry 4.0
- The multi-attribute mode
- An Overview of a Smart Manufacturing System Readiness Assessment
- The Connected Enterprise Maturity Model
- IMPULS—Industry 4.0 readiness
- Digital readiness for Industry 4.0
- SIMMI 4.0
- Towards a Smart Manufacturing Maturity Model for SMEs
- The Logistics 4.0 Maturity Model
- A Smartness Assessment Framework for Smart Factories Using Analytic Network Process
- Croatian Model of Innovative Smart Enterprise (HR-ISE model)
- Maturity and Readiness Model for Industry 4.0
- AMM (Adoption Maturity Model)
- Three Stage Maturity Model in SMEs

Additionally, Schumacher et al (2016) have extended the research on DMMs to include not only functional but also organizational metrics, such as “strategy”, or “leadership” further emphasizing the need for a holistic approach.

This research aims to gain insight into the drivers of digitalization capabilities in Finnish SMEs, contributing to the broader discourse on DMMs. By focusing on the perceived benefits of digitalization and the importance of various technologies, this study seeks to identify the key motivators and barriers influencing the digital transformation journey of SMEs. Understanding these factors is crucial for developing tailored strategies that support SMEs at different stages of digital maturity.

2. Theoretical Background

When assessing the digital maturity of a company in the Finnish context, the choice of measure variables was made to ensure that the results would be comparable with previous Finnish research. To align the existing literature with the DMM context, a cross-reference between the components of the most popular DMMs and a study by Kääriäinen et al. (2019) from the VTT Technical Research Centre of Finland was conducted. The maturity variables from Kääriäinen et al (2019) include:

- The use of corporate website solutions
- The use of social media solutions
- The use of digital calendar solutions
- The use of web conferencing solutions
- The use of digital accounting solutions
- The use of e-commerce solutions
- The use of cloud service solutions
- The use of e-purchase solutions
- The use of artificial intelligence (AI) solutions
- The use of Big Data solutions
- The use of IoT solutions
- The use of customer relationship management (CRM) solutions

By cross-referencing these maturity variables with the IMPULS (Lichtblau et al 2015), PwC (Geissbauer et al 2015), and Deloitte (Deloitte 2018, Kiron et al 2016) model components, we can see that most of the proposed maturity variables exist within the models (Table 1).

Table 1: Digitalization maturity variables used in the research and their appearance in IMPULS, PwC, and Deloitte DMMs

Digitalization Variable	IMPULS	PwC	Deloitte
Utilization of web-based applications or websites	X	X	X
Utilization of social media presence	X	X	X
Utilization of ecommerce solutions	X	X	X
Utilization of video conferencing solutions			
Utilization of cloud services	X	X	X
Utilization of electronic scheduling solutions			
Utilization of electronic purchase solutions	X	X	X
Utilization of Artificial Intelligence	X	X	X
Utilization of Big data	X	X	X
Utilization of Internet of Things	X	X	X
Utilization of electronic accounting solutions	X		X
Utilization of CRM solutions	X	X	X

Even though video conferencing or electronic scheduling solutions were explicitly absent from the examined models, their relationship with these models can be inferred by examining model components such as “Ecosystem management,” “Applications,” and “Workforce enablement” (Deloitte model), “Information sharing” (IMPULS model).

When adopting new technologies, companies must have a primary motivation to do so. The most widespread and cited technology adoption model is likely the Technology Acceptance Model (TAM) by Davis (1989), extended by Venkatesh and Davis (2000) and Venkatesh et al (2003). Across all these major models, the user's perception of the benefits derived from using digital technology is a central and critical driver of their intention to adopt and use it. The belief that the technology will provide tangible advantages (like improved performance, efficiency, and effectiveness) is consistently shown to be a powerful predictor of acceptance. Moreover, putting the utilitarian, performance-based motivations aside, there might also be a suite of “necessary” activities the SMEs need to perform in order to improve their digital transformation. These activities can be related to e.g. compliance, security, strategic alignment, or social necessity, and are linked to the Performance expectancy,

Social Influence, and Voluntariness of Use components in the United Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh et al 2003). These two dimensions provide the framework for the final input variables in this research. In line with Kääriainen et al (2019), both the Importance and Benefit dimensions have been further expanded to include the following elements (Table 2):

Table 2: The measured Importance and Benefit dimensions used in the research

Importance	Benefit
Digital marketing	Time-saving
Customer experience	Travel costs
Cybersecurity	Customer needs
Digitized material	Operational efficiency
Data, AI	New business models
Cloud services	New partnerships
Digital sales	
Internal processes	

As this research aims to gain insight into the digitalization drivers by using the introduced Importance and Benefit components of digital activities, the first task will be categorizing SMEs based on their digital capabilities by using the digitalization maturity variables. We will utilize a three-tiered approach suggested by Kiron et al (2016), where SMEs will be classified as "Early", "Developing", and "Maturing" based on their digital activities. This topic has previously been explored by the author (Väisänen 2023) and thus, the level of digitalization will serve as the target variable for this research. Once the three clusters of SMEs have been established, the effect of each component in the Importance and Benefit dimensions placing the respondent company into a specific cluster will be analyzed.

3. Empiric Part

The data for this research was collected by a Finnish research agency for the LAB University of Applied Sciences' Digital Innovation Hub project in winter 2021, and targeted the southeastern region of South Karelia in Finland. The Finnish enterprise landscape, like the EU, is dominated by micro-organizations (Statista 2022; Statistics Finland 2022). Observations from all SME sizes were needed to get a comprehensive view of digitalization, as larger SMEs likely have different digitalization needs due to more resources. Stratified sampling was used to avoid oversampling smaller companies and gain insights from a smaller subset of larger SMEs (Iarossi 2006, p. 99). A phone survey targeting 1,000 respondents in southeastern Finland was chosen for higher reliability. Interviewers called companies from a stratified list proportional to personnel categories, moving to the next stratum once enough responses were received. The final sample size was 1,002 respondents. The digitalization maturity variables, determining to which cluster an SME belongs, was measured in the following three-point scale: 1=respondent does not use this technology and doesn't intend to do so in the future, 2=respondent does not use this technology but is looking to do so in the future, 3=already uses this technology.

K-means cluster analysis was chosen to analyze the digital profile of the companies without pre-existing assumptions. This method groups homogeneous data points together, ensuring heterogeneity between groups (Larose and Larose, 2014, pp. 211–212). The algorithm automatically classifies findings, requiring no prior knowledge of the population. The number of clusters was determined to be three to follow the approach by Kiron et al (2016), but also so that low-, mid- and high-tier SMEs could be identified and mitigate the risk of fragmenting the data into unnecessarily small clusters.

The clustering process yielded three clearly different clusters of SMEs based on their digital technology usage (Figure 1). Of the three clusters, one (n=386) was clearly under-utilizing digital technologies all across the board compared to the other two clusters. The next group (n=506) performed better but remained in a comparatively similar level regarding AI, data, and IoT usage. The final group (n=110) was the smallest of all but excelled in AI, data, and IoT usage. These results provide further validation to the connection with the existing DMMs, as they proportionally reflect the "Early", "Developing", and "Maturing" groups from the Deloitte DMM (Kiron et al 2016).

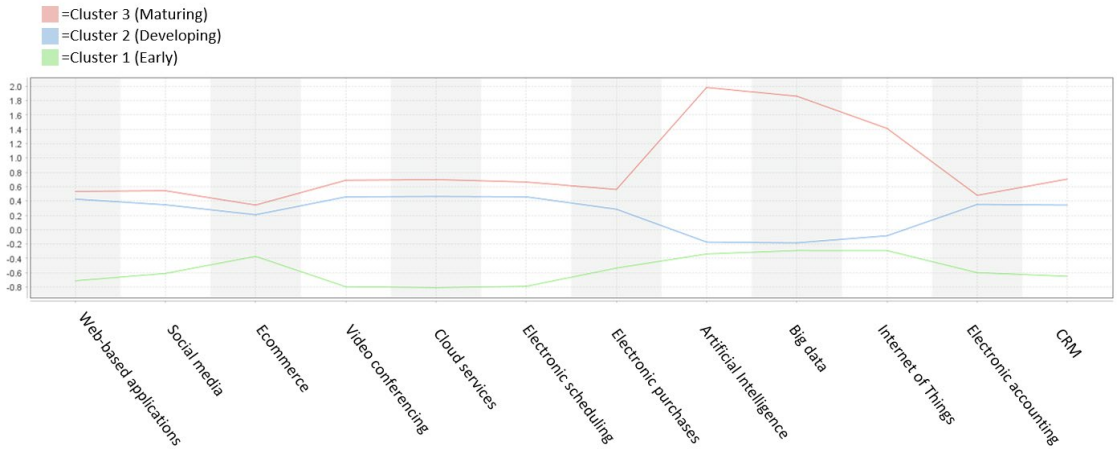


Figure 1: Distribution of digital maturity variables by cluster. Higher values represent higher usage.

Once the three clusters were identified, the next step was to understand the role of each component in the Importance and Benefit dimensions when predicting a company's association with each cluster. The dataset measured each of these components in a five-point Likert scale. The following six logistic regression models were created as binary classification tools for predicting if a company belongs to a specified cluster by using the components from the Importance and Benefit dimensions:

- Model 1.1 Effects of Importance dimensions when the company belongs to cluster 1 (Early)
- Model 1.2 Effects of Benefit dimensions when the company belongs to cluster 1 (Early)
- Model 2.1 Effects of Importance dimensions when the company belongs to cluster 2 (Developing)
- Model 2.2 Effects of Benefit dimensions when the company belongs to cluster 2 (Developing)
- Model 3.1 Effects of Importance dimensions when the company belongs to cluster 3 (Maturing)
- Model 3.2 Effects of Benefit dimensions when the company belongs to cluster 3 (Maturing)

Logistic regression offers a valid understanding of the mechanics behind classification and is commonly used in SME research. It can also perform comparatively against more complex methods, such as artificial neural networks (Abdin et al. 2020). To improve the validity and accuracy estimation of the results, a 10-fold cross-validation technique was used when constructing the models. By examining the results from the logistic regression models, we get the following six models with statistically significant ($p < 0.05$) dimensions highlighted (Tables 3-8):

Table 3: Model 1.1. Effects of Importance dimensions for Early companies.

Importance Dimension	Standardized Coefficient	p-value
Digital marketing	**0.528**	**0.000**
Customer experience	**0.257**	**0.049**
Cybersecurity	0.063	0.578
Digitized material	-0.135	0.218
Data, AI	-0.134	0.309
Cloud services	**0.7187**	**0.000**
Digital sales	-0.056	0.670
Internal processes	**0.652**	**0.000**

Table 4: Model 1.2. Effects of Benefit dimensions for Early companies

Benefit Dimension	Standardized Coefficient	p-value
Time-saving	**0.552**	**0.000**
Travel costs	0.009	0.926
Customer needs	0.202	0.075

Benefit Dimension	Standardized Coefficient	p-value
Operational efficiency	**0.472**	**0.000**
New business models	0.078	0.532
New partnerships	**0.310**	**0.009**

Table 5: Model 2.1. Effects of Importance dimensions for Developing companies

Importance Dimension	Standardized Coefficient	p-value
Digital marketing	**0.380**	**0.001**
Customer experience	0.203	0.091
Cybersecurity	0.166	0.102
Digitized material	0.008	0.928
Data, AI	**-0.819**	**0.000**
Cloud services	**0.412**	**0.000**
Digital sales	0.099	0.383
Internal processes	**0.581**	**0.000**

Table 6: Model 2.2. Effects of Benefit dimensions for Developing companies

Benefit Dimension	Standardized Coefficient	p-value
Time-saving	**0.391**	**0.000**
Travel costs	0.003	0.974
Customer needs	-0.036	0.734
Operational efficiency	**0.244**	**0.014**
New business models	0.012	0.918
New partnerships	**0.311**	**0.004**

Table 7: Model 3.1. Effects of Importance dimensions for Maturing companies

Importance Dimension	Standardized Coefficient	p-value
Digital marketing	0.185	0.397
Customer experience	0.229	0.325
Cybersecurity	-0.189	0.372
Digitized material	-0.295	0.053
Data, AI	**1.207**	**0.000**
Cloud services	**0.788**	**0.000**
Digital sales	-0.294	0.096
Internal processes	0.062	0.751

Table 8: Model 3.2. Effects of Benefit dimensions for Maturing Companies

Benefit Dimension	Standardized Coefficient	p-value
Time-saving	**0.465**	**0.019**
Travel costs	0.076	0.547
Customer needs	**0.790**	**0.000**
Operational efficiency	**0.422**	**0.019**
New business models	0.021	0.911
New partnerships	-0.076	0.662

Logistic regression models were employed to determine which factors (Importance and Benefit dimensions) significantly predicted membership in each cluster. For Early SMEs (Cluster 1) higher perceived importance of digital marketing, cloud services, and internal processes significantly increased the likelihood of belonging to this cluster. Importance of customer experience also showed significance. Higher perceived benefits in time saving, operational efficiency, and new partnerships were significant predictors. For Developing SMEs (Cluster 2) higher perceived importance of digital marketing, cloud services, and internal processes were significant predictors. Notably, a lower perceived importance of data and AI strongly predicted membership in this cluster. Higher perceived benefits in time saving, operational efficiency, and new partnerships were significant predictors. For Maturing SMEs (Cluster 3) a significantly higher perceived importance of data and AI and cloud services were the strongest predictors for this cluster. Higher perceived benefits in time saving, understanding customer needs, and operational efficiency were also significant predictors.

4. Conclusion

This research aimed to provide insight into the drivers influencing the digital capabilities and maturity of Finnish SMEs, contributing to the understanding of Digital Maturity Models (DMMs) in this context. By analyzing the perceived importance of various digital activities and the anticipated benefits of digitalization, the study successfully categorized SMEs into three distinct maturity clusters – Early, Developing, and Maturing – mirroring stages found in established DMM frameworks. Logistic regression analysis further illuminated the specific factors that differentiate these clusters. To address the validity of the results, the accuracy of each model was calculated. The accuracy scores of the models ranged from 63% (predicting classification into Developing SMEs using benefit dimensions as predictors) to 84% (predicting classification into Maturing SMEs using importance dimensions as predictors).

4.1 Theoretical Implications

The emergence of three distinct clusters based on technology usage empirically supports the tiered structure common in many DMMs, suggesting these models are applicable in the Finnish SME context. Additionally, the findings extend technology acceptance theories like TAM and UTAUT. While perceived benefits (like time savings and operational efficiency) are important across clusters, aligning with 'perceived usefulness' or 'performance expectancy' components of the models, the specific drivers vary significantly from cluster to cluster. For instance, the importance of 'data and AI' starkly differentiates Maturing SMEs from Developing ones, indicating that drivers evolve as maturity increases. The consistent importance of 'cloud services' and 'internal processes' for Early and Developing clusters might relate to foundational 'effort expectancy' or enabling conditions in UTAUT. While not directly measured, the results implicitly connect to absorptive capacity, as Maturing SMEs' focus on advanced technologies like AI and data suggests a higher capacity to recognize, assimilate, and apply complex digital knowledge compared to less mature SMEs.

4.2 Practical Implications

Understanding the distinct drivers for each cluster allows policymakers and support organizations in Finland to design more targeted interventions. For Early and Developing-stage SMEs the impact of cloud services as a necessity driver coupled with the need to improve internal processes suggests that improved uptake on utilizing cloud services would benefit them in organizing their activities in a more efficient manner, while Maturing-level SMEs most likely would benefit from supporting their data and analytics architecture through cloud services. Interestingly, only in the Maturing-level cluster was the use of AI deemed as a statistically positive indicator, making a case of demystifying AI or finding practical applications and use cases for it, a lucrative approach for accelerating Developing companies' digital transformation. Equally interestingly, the only negative statistically significant predictor was the perceived importance of AI and data when predicting the classification into a Developing SME. These findings would suggest that there might be a gap between the perception of the suitability of AI solutions between Developing and Maturing SMEs. To overcome this gap, the organizational DMM components from Schumacher et al. (2016) are more likely to be addressed than just technology uptake.

Ethics Statement

Ethical clearance was not required in this research. All necessary permissions for research were obtained at the time of interviews, and the data used in the analysis was anonymized.

AI Declaration

Generative Artificial Intelligence tools were used in the generation of this paper the following way: 1) Proofreading and grammatical errors (Grammarly), 2) Refining the overall tone of the text and checking for inconsistencies (Gemini 2.5).

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Developing Cyber-Physical Systems as Entrepreneurs: Agile Development in Startups and SMEs

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Abstract: As mechatronic systems evolve into cyber-physical systems (CPS) through IoT integration, start-ups face unique challenges in CPS development due to limited knowledge, resources, and time. Although they often adopt agile methods, this is typically done unconsciously. Prior research highlights four key problem areas: unclear entrepreneurial motivation, uncertainty in idea validation, resource-constrained prototyping, and low acceptance of tools and methods. Building on earlier exploratory studies, this paper presents a systematic literature review (SLR) of 1,929 papers to analyse CPS engineering practices across start-ups, SMEs, and large enterprises. We identify the types of CPS developed, compare engineering approaches, and propose a framework to classify CPS projects by organizational type and system level. The study outlines best practices and key requirements for successful CPS development and offers guidance to support tailored toolkits for diverse development contexts.

Keywords: Cyber-physical systems, Agile Development in Start-ups, Entrepreneurship With Cyber-physical Systems, Problems of Product Development in CPS-startups, Product Development Characteristics of CPS-Startups

1. Introduction

Although European industries are known for their ingenuity in developing high-tech products in hardware-intensive industry sectors (European Comission, 2021), the focus of startups tens more on the development of products with a high share of software development: In 2023, only a fifth of German startups identify technology development and production as their business model, while 65% of them identify an exclusively digital business model in their startup. (Kollmann et al., 2023) These numbers slightly vary for other years (Hirschfeld et al., 2024), but the overall trend is still represented in current data and publications in research of entrepreneurship, e.g. (Kollmann, 2022). Recent studies indicate that this is due to a discrepancy between idealized frameworks aimed at software projects (Völk et al., 2024). This becomes a problem when focussing on products that are not exclusively software such as CPS: they are integration of computation with physical processes (Lee, 2010) expanding mechatronic systems through the possibilities of the Internet of Things (Graessler & Hentze, 2020). According to Griffor et al., cyber-physical systems (CPS) can be categorized into three scopes: (1) Single CPS Devices, which refers to a basic CPS component or subsystem; (2) System CPS, which denotes an integrated system composed of multiple CPS components; and (3) System-of-Systems CPS (SoS CPS), which describes a higher-level assembly of multiple independent CPS systems.(Griffor et al., 2017) These classifications are also grounded in Ropohl's system theory.(Ropohl, 2009) In our study, we adopt a similar categorization and cluster CPS into three hierarchical levels, as illustrated in Figure 1: (1) Subsystem CPS, (2) System CPS, and (3) System-of-Systems (SoS) CPS.

We see that those systems have a high innovation potential but still are facing significant challenges in their deployment. Especially startups face significant challenges regarding the development of CPS, as regular approaches for startup engineering fail to address problem fields in the engineering of hardware-heavy or cyber-physical systems (CPS) (Völk et al., 2024).: Founders in CPS engineering are mostly technology-affine engineers looking for a challenge based on an initial idea mostly motivated from single domain viewpoints. They regularly lack an integrated innovation view of their product, while they have to mature the hardware systems early and fast, which results in development speed and resource usage as key parameters of the development.

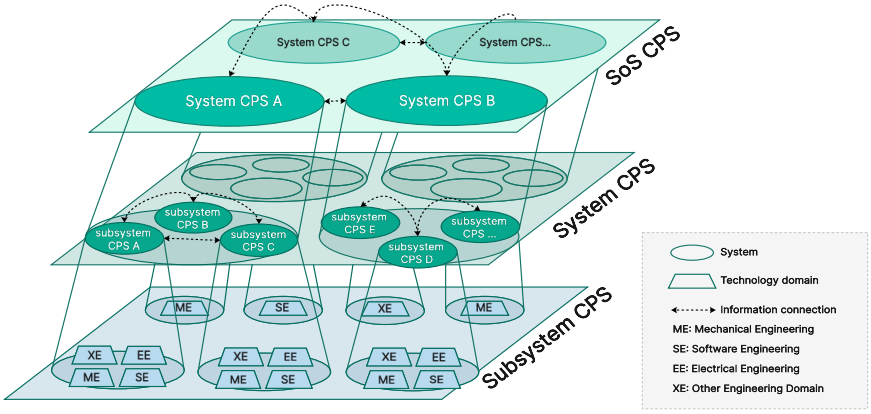


Figure 1: CPS levels. Own illustration

Especially the last characteristic logically results into adaption of agile practices in startups. Agility is the ability to rapidly and continuously adapt a development process in a situation- and demand-oriented way (Albers et al., 2021). Studies show that development in startups in general is implemented in an agile way (Pfaff et al., 2021). In the state of research, we do only have insights into specific CPS use-cases (Yeman & Malaiya, 2024) and still lack general insights into agile development practices in CPS engineering (Ahmad, 2020), especially for startups. To create meaningful support in designing processes and methods, we need an understanding of unique requirements, attributes or practices of agility in the engineering of CPS on different organizational levels.

2. Research Aim, Research Questions, and Methodology

This study aims to better understand the dependency of the type of an organization to its deployment of agile practices in the context of the engineering of cyber-physical systems already present in established literature. To achieve this, we want to answer the following research questions (RQ):

- *RQ1: How do different types of organizations apply agile methodologies in their cyber-physical systems (CPS) engineering processes*
- *RQ2: What are the key similarities and differences in agile practices between established companies and startups in CPS development?*

3. Systematic Literature Review on Agile Product Development Practices in Engineering of Cyber-physical Systems in Different Organization Types

To address the research questions, a systematic literature review (SLR) is conducted to filter the relevant study in the first step. The review followed established guidelines recommended by (Heil, 2021) and the well-known guidelines of (Kitchenham et al., 2009). The adopted process is described in Figure 1.

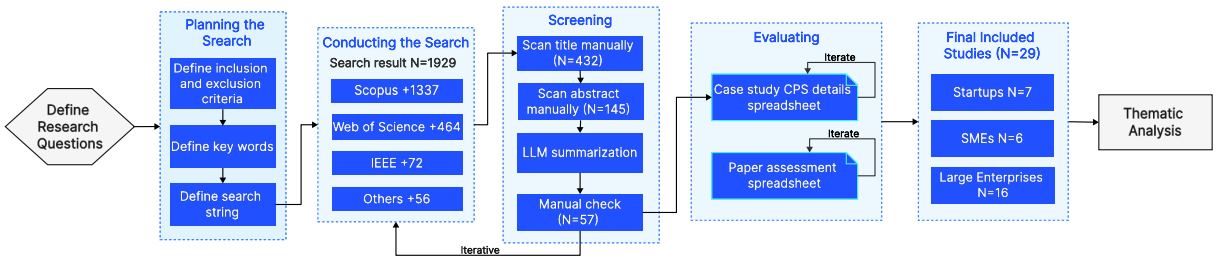


Figure 2: Systematic literature review adopted in this study. Own illustration

In the research planning phase, clear criteria were established to determine which studies would be included. Guided by the criteria, a set of keywords were identified from search topic. Boolean operators were used to construct search strings that combined these categories. This resulted into the following search string:

Search string: ST = [CPS] + [Product development] + [Agile] + [Organization type] + [Study type]

In more detail, the example search string could appears as follows:

"cyber-physical system" OR "CPS" OR "industrial automation" OR "IIoT") AND ("product development" OR "system engineering" OR"prototyp*”) AND ("agile methodolog*" OR "scrum" OR "kanban") AND ("startup*" OR "early-stage compan*”) AND ("case stud*" OR "empirical stud*" OR "industrial experience*" OR "practical application*" OR "failure analys*")*

The search was conducted across multiple academic databases, including Scopus, Web of Science, IEEE Xplore, ACM Digital Library, and others, covering literature published from 2014 to 2024. The application of the search string on these databases resulted in 1929 found papers.

To evaluate the papers fit to the research problem, we first scanned each research by title, then by the abstract. By the end of the abstract screening, there were 145 publications that appeared to match the defined inclusion criteria. To manage the amount of data, the Large Language Model Perplexity was used to summarize:

- Contextual Information of the given research including industry, project scale and organization type.
- CPS characteristics including-the hardware scope, connectivity technology and the CPS “level”.
- The chosen development approach, in specific agile practices.
- Key findings as technical, process, and organizational insights

Each paper was uploaded individually into Perplexity to avoid information mixing and are reviewed manually. Each summary including the references to the actual paper was compared to the actual content of the paper, so no alteration based on mistakes the AI could do can alter the result of the analysis. After this quality insurance step, 57 out of the 145 papers were flagged as likely meeting all inclusion criteria. 6 Quality Assessment Criteria were set to evaluate 57 study candidates: (1) Is the scientific idea validated? (2) Is the case study validated as CPS engineering? (3) Does the publication focus on product development? (4) Is there any agile approach mentioned by the publication? (5) Does the publication include a personal opinion piece or viewpoint? (6) Has the publication been cited by other authors? Papers that do not meet QA1, QA2 and QA4 were excluded from further data analysis resulting in Figure 2 describes the results of the final included 29 studies in this SLR.

Following the approach outlined by Braun and Clarke, the analysis proceeded through the following steps: (1) familiarization with the data in the spreadsheets; (2) generation of initial codes by extracting relevant quotes from the studies; (3) identification of themes related to agile practice drivers, agile approaches, challenges, and CPS system levels; and (4) review and refinement of themes by clustering sub-themes into broader categories. The resulting set of literature is shown in Table 1.

Table 1: Overview of CPS agile development approach in this SLR

Source	ID	Approaches and Main Ideas
(Völk et al., 2024)	[1]	CPS Development Challenges – Startups face typical CPS challenges; use rapid prototyping instead of formal Agile.
(Julianasari et al., 2022)	[2]	Scrum Fail Analysis – TOPSIS reveals Scrum failed in CPS startup; better Agile planning advised.
(Vecchio et al., 2021)	[3]	Open-Source IoT – Modular open-source IoT platform enables fast, low-cost CPS prototyping.
(Berg et al., 2020)	[4]	Hardware Agile Practices – 5 CPS startups use tailored Agile; quality focus needed for long-term agility.
(Nguyen Duc et al., 2019)	[5]	MVP in IoT – Six CPS startups use MVPs and Agile, adapted for hardware constraints.
(Chiang & Lee, 2017)	[6]	Lean via Internet of Makers (IoM) – Small CPS firms cut development costs using IoM; share design files to speed up smart manufacturing.
(Nguyen Duc et al., 2018)	[7]	Hardware Agile Practices – Study shows tailored Agile in hardware startups; 3D printing, sprints, and vendor collaboration enable speed.
(Fritzsch et al., 2023)	[8]	DevOps & Microservices in CPS – Microservices and DevOps used in CPS, but need hardware adaptation
(Michalides et al., 2023)	[9]	Challenges in Scaled Agile – Challenges in Scaled Agile – Scaling Agile in hardware teams faces sync and resource issues.
(Tapio Schrey et al., 2022)	[10]	KONE’s Agile Transformation – KONE uses Agile to shorten cycles and align with digital services.

Source	ID	Approaches and Main Ideas
(Kasauli et al., 2020)	[11]	Agile-Waterfall – Agile teams struggle with requirements in a waterfall-driven EV company.
(Cooper & Sommer, 2018)	[12]	Agile–Stage-Gate (ASG) – Agile sprints embedded in Stage-Gate boost speed and flexibility in manufacturing. (General Electric Company, Danfoss, Honeywell, Chamberlain)
(Salvato, 2018)	[13]	Agile–Stage-Gate-Management (ASGM) – ASGM integrates Agile practices (e.g., Scrum) into Stage-Gate for hardware
(Schmidt et al., 2018)	[14]	Hardware Agile Practices – Scrum/Kanban help manage rapid hardware changes, though not fully iterative.
(Sommer et al., 2015)	[15]	Agile–Stage-Gate – Combines Scrum at team level with Stage-Gate oversight for better product performance.
(Chai et al., 2018)	[16]	INDICS Smart Platform – INDICS combines IoT, AI, and lean to support smart factories, with SME use cases
(Fuchs & Hess, 2017)	[17]	Scrum for Industrial IoT **(IIoT) – Customized Scrum with coordination cycles fits complex IIoT projects.**
(Marlene Sharkey, 2023)	[18]	Honeywell's Agile Transformation – Agile pilot (Scrum/Kanban) speeds hardware delivery and boosts engagement
(Robin Yeman, 2025)	[19]	Success Patterns in Building CPS with Agile – Agile/DevOps practices enable large, safety-critical CPS development.
(Vodyaho et al., 2022)	[20]	Agile CPS Architecture **– Agile architecture for CPS uses knowledge graphs and automated modelling.**
(Erdin & Olcay, 2024)	[21]	Agile–Stage-Gate – Tailored hybrid ASG segments projects by complexity/TRL; SME battery case.
(Jusoh et al., 2019)	[22]	Agile Use in IoT SMEs – Malaysian SMEs mainly use Scrum for IoT/CPS development.
(Schuh et al., 2019)	**[23]**	Finding the Right Development process for CPS – Method for selecting best CPS development process by project conditions
(J. Hernández-Reveles et al., 2016)	**[24]**	Scrum + Agile Architecture – Scrum and specific architecture practices (runway, enabler stories, docs) for MVP.
(Khan et al., 2024)	[25]	Enhanced Agile V-Model: Hybrid V-model combines traditional V-model with Agile for regulated medical devices.
(Cederbladh et al., 2024)	[26]	CPS Collaboration Challenges - Key hurdles (data, modelling, automation) in agile CPS collaboration from EU project.
(D. Roy et al., 2018)	[27]	Multi-domain Agile CPS - Coupling domains and automation enables safe, agile automotive CPS.
(Luedeke et al., 2018)	[28]	CPM/PDD Agile Integration - Combines design thinking and Agile with CPM/PDD modelling for CPS.
(Yeman & Malaiya, 2024)	[29]	Agile adoption in CPS grows but faces regulatory and complexity challenges.

4. Results of the Systematic Literature Review

Organizations across various sectors have adopted agile methodologies in cyber-physical systems (CPS) engineering, with adoption patterns differing significantly based on organizational size, domain, and culture. A total of 53 case studies were identified from the selected publications. Figure 3 presents the distribution of these case studies by industry domain. The majority are from large-scale industrial automation and Industrial Internet of Things (IIoT) projects, followed by a substantial number in the medical devices and systems sector. Startups are primarily represented in the consumer electronics and medical device domains, while small and medium-sized enterprises (SMEs) are predominantly involved in industrial automation and IIoT.

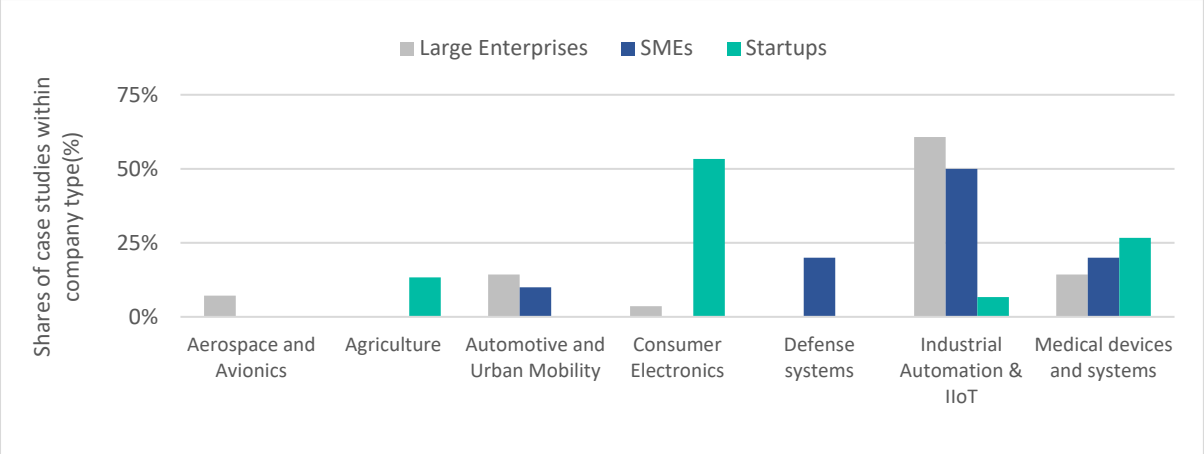


Figure 3: Number of case study in the included paper by industry domain

4.1 CPS Level Corresponding to the Organizational Maturity

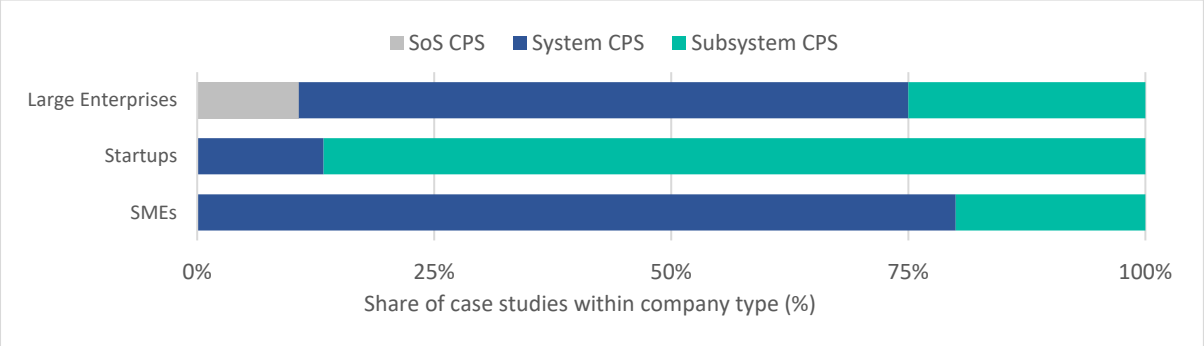


Figure 4: Organizational Case Studies by CPS Level

The data observed from the 53 case studies suggest that system complexity tends to increase with organizational maturity as shown in Figure 4. Startups primarily focus on **Subsystem CPS (**e.g. [5, 6]), small and medium-sized enterprises (SMEs) are mainly involved at the **System CPS** level (e.g. [3, 22, 23]), and large firms predominantly engage with **System CPS** as well. Additionally, there are three documented cases involving **System-of-Systems (SoS) CPS (e.g. [8])**, which are typically associated with the most mature and complex organizational settings. This seems clear: The threshold entering a sub-system (or component) level of a complex system is not as big as for a big SoS solution, so big companies have no advantage in competing with startups with no previous knowledge. Still, this should not be seen as an absolute allocation, but rather an indication of the current state in research. Yet, to get a fully functional CPS, all different layers have to be represented, implying that a successful integration of a subsystem CPS made by a startup needs a bigger framework crated by an SME or large company where the solution can get adapted into.

4.2 Drivers of Implementing Agile Practices

Adaptability is the primary reason organizations adopt agile practices. Startups, operating under high uncertainty, need flexible methods to handle evolving requirements [5][7]. Agile approaches emphasize responsiveness to change in dynamic settings [1][4][7], which is equally vital for SMEs facing shifting market demands [21]. The ability of agility to integrate new requirements, insights, and customer feedback throughout development is a key advantage [23].

For startups, speed is the second major driver, essential for meeting time-to-market demands [2][4][5][6][7]. As one study notes, “the competitive environment of hardware startups makes speed inevitable” [4]. In contrast, SMEs prioritize customer-driven development slightly above speed. For instance, in a medical device case study, agile was combined with the V-model to incorporate feedback from patients and doctors [25]. In Make-to-Order (MTO) settings, SMEs rely on agile methods like Scrum sprints to respond quickly to client needs and integrate changes efficiently [17][22][24]. Tools like user stories help Product Owners align requirements with buyer expectations [24].

4.3 Different Agile Practices Across Organizations

Agility is the ability to rapidly and continuously adapt to both expected and unexpected changes, ideally turning them into opportunities. This study identifies two main categories of agile practices.

- Process-Oriented Practices: These span from organizational-level models to team and individual execution frameworks. Gren emphasizes the importance of addressing agility at macro (organization), meso (team), and micro (individual) levels for coherent implementation [Gren, 2017].
- Technology-Oriented Approaches: These embed adaptability into system architecture and design, enabling long-term responsiveness in complex environments.

Startups typically operate at the subsystem CPS level [2][4][5][6], prioritizing speed and minimizing upfront planning and documentation [1][4]. They often accept technical debt to validate concepts quickly, using mock-ups or partial prototypes instead of full hardware–software integration [5]. Agile practices are informal and team-focused, including simplified Scrum, ad-hoc methods, and extended sprints [5]. However, partial adoption can reduce effectiveness—e.g., one Agri-tech startup using partial Scrum completed only 50% of tasks per iteration [2]. Technology-oriented practices include rapid prototyping (e.g., 3D printing, CAD) and open-source IoT platforms to cut costs and development time [5][7].

SMEs focus on system-level CPS development [21][22][23][24], aiming to boost efficiency, speed, and stakeholder satisfaction [16][21–25]. They often combine agile with plan-driven models [21][23][25], especially architecture-centric ones [24]. Scrum is the most common framework [4][17][22], with projects split by domain and executed in short sprints [23]. Hybrid models (e.g., Scrum with Stage-Gate or V-model) balance flexibility and structure [21][23][25]. Technology-oriented practices include reusable platforms and AI-enhanced decision-making. For example, the INDICS platform supports intelligent factories through data-driven efficiency and quality improvements [16].

Large enterprises are increasingly applying agile to physical product development, extending its use from software to mechatronic and CPS systems [9]. These firms often develop CPS at the system or SoS level, frequently in collaboration with universities [26–28]. Their goals include market responsiveness, safety, collaboration, and customer satisfaction [8][10–15][17][18][26][29]. Agile is typically used at the team level, while plan-driven models remain at the macro level for compliance [11–13][15][21][23][25]. Common methods include Scrum, Kanban, Design Thinking, and DevOps [8][13–15][17–19][26][28], often within hybrid models (e.g., Agile-Stage-Gate, Agile-V-Model) [11–13][15][21][23][25]. Safety frameworks like FMEA ensure regulatory compliance [29], while CPM/PDD links design to implementation [28]. Technology-oriented practices include Agile Architecture [20], Digital Twins [19][20][29], CI/CD [26], Microservices [8], MDE [8], AI/ML [26], and agile tools like Jira [11][18].

4.4 Challenges of Implementing Agile Practices

The results identified agile practice challenges in 9 categories and compare them across different organizations as shown in Figure 5. Startups, SMEs, and large CPS organizations face several key challenges when adopting agile practices. Process and workflow issues arise due to the mismatch between agile methods and hardware development. Hardware constraints make rapid iterations costly and slow. Limited resources and expertise, especially in project management, hinder implementation. Cultural resistance and rigid hierarchies slow agile adoption. System complexity, including IoT integration, complicates coordination. Safety and compliance requirements conflict with agile's flexibility. Organizational restructuring is often needed but difficult. Teams face a steep learning curve, especially with partial agile use. Lastly, sharing development data can lead to intellectual property concerns as operations scale.

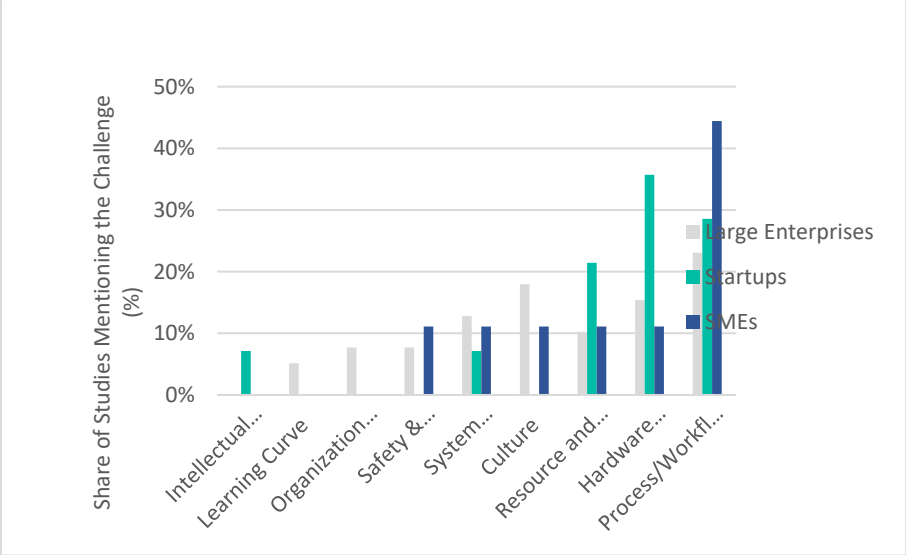


Figure 5: Agile practice challenges in CPS engineering across organizations

5. Summary and Outlook

This study presents a comprehensive review of the current state of research on the adoption of agile practices in the engineering of cyber-physical systems (CPS) across different types of organizations. From an initial pool of 1929 papers, 29 were systematically selected to analyse the prevailing challenges and practices among startups, small and medium-sized enterprises (SMEs), and large companies. Our findings suggest that the level of manageable complexity is connected to the organizational maturity: startups typically focus on developing individual CPS components, SMEs tend to integrate CPS, and large companies often connect CPS into broader Systems-of-Systems. This progression is also reflected in the application of agile practices. While all types of organization value adaptability, their motivations differ: startups generally lack prior knowledge and seek to acquire it rapidly, whereas SMEs and large companies possess substantial knowledge but struggle to apply it in a context-sensitive and needs-driven manner. These differences are also evident in the challenges reported: Case studies on startups often emphasize hardware constraints, while those on SMEs and large companies highlight issues related to complexity and process management. This results into two differing views on agility: Startups tend to organize their agile approaches unstructured facilitating them there needed, while established firms apply agility in a stricter and more structured way. Notably, findings are mainly limited to the current state of research. As startups tend to focus on their own progress and less on research collaborations, there might be a limitation to the findings shown based on the different motivation to participate in active research.

Nevertheless, the results lead to a critical implication for the design of tools and methods: researchers cannot assume that solutions tailored to one organizational type will be effective for others. Challenges of and reasons for the application of agility highly differ by the maturity of the organization wanting to apply them. While our results are only based on the assessment of agility, we state that this is transferable to the overall motivation for the usage of processes, methods and tools. Future research should therefore focus on identifying the core requirements of each organizational type. While SMEs and large companies have already received considerable attention, startups represent a promising and underexplored area in (agile) process development research.

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Ethics and Artificial Intelligence (AI) Declaration

No ethical clearance was required. AI was used as indicated in section 3 and for editorial changes.

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Digital Entrepreneurship Competencies: Empowering Rural Youth through Microcredentials

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Abstract: The aim of this research is to analyse the impact of microcredentials-based training on the development of digital competencies among young people living in rural areas. The authors hypothesise that participation in microcredential-based training significantly improves digital and entrepreneurial competencies, as well as self-confidence and initiative among rural youth. The research seeks to understand how acquiring such competencies affects young people's attitudes toward entrepreneurship and their ability to apply digital tools effectively. Additionally, the study aims to identify how the integration of these two domains – digital competences and entrepreneurship – can contribute to reducing the competences and employment gap in rural regions. The study involves a sample of 200 young people (aged 18–30) from rural areas, who are mainly at the early stages of their professional careers and have limited access to digital resources and/or entrepreneurial education. Participants are engaged in training modules focused on entrepreneurship and digital competencies, allowing for the assessment of the impact of such training on both their personal and professional development. A mixed-methods approach is employed, combining survey questionnaires and comparative analyses to gather both qualitative and quantitative data. The survey questionnaires explore participants' experiences and perceptions of entrepreneurship and the use of digital tools, while the comparative analyses allow for evaluation of the effectiveness of the training in shaping attitudes among rural young people. The research provides insights into the effectiveness of microcredential-based training in enhancing digital and entrepreneurial competences. It contributes to a better understanding of how these competencies influence the potential career development of young people in rural communities. The innovative aspect of this research lies in the application of microcredentials – modern, modular form of learning – in the context of rural youth, while integrating two critical areas: digital competencies and entrepreneurship. This is the first study of its kind to explore this intersection from an academic perspective, offering new insights into the transformative potential of competence development for rural economies.

Keywords: Microcredentials, Digital Competences, Entrepreneurship, Rural Areas, Young People.

1. Introduction

The transformation of rural economies in the context of digitalisation and entrepreneurship has become a central theme in contemporary research on youth employment (e.g.: Saxena 2012; Mazumdar & Ahmed, 2015; Lekhanya 2018). Rural areas in Europe continue to face persistent socio-economic disparities, including limited access to quality education, digital infrastructure, and employment opportunities (Akifieva et al., 2021; Stojanova et al., 2022; Liu & Li, 2024). These challenges are particularly acute for young people, who often encounter structural barriers to entering the labour market or launching entrepreneurial ventures in rural settings (Hotge & Whitby, 2024). At the same time, rural development strategies increasingly underline the role of digital skills and social entrepreneurship as key drivers of youth development (Elia et al., 2020; Rijswijk et al., 2021).

Digital competencies, defined as the confident and critical use of information society technologies for work, leisure, and communication (Heine et al., 2023), are no longer optional, but essential (Peiro & Martinez-Tur, 2022), especially in the context of rural development. Research indicates that rural youth are often lacking digital literacy, due to infrastructural gaps and insufficient training opportunities (Arslan et al., 2021). As such, equipping young people in rural areas with digital competencies is seen not only as a response to the digital development, but also as a foundation for enhancing their employability, social participation, and entrepreneurial capacity (Palacios-Rodriguez 2023; Tomczyk 2024).

On the other hand, entrepreneurship, characterised by the pursuit of innovative solutions to environmental, social, and economic challenges through entrepreneurial approaches, has gained attention as a tool for community empowerment and sustainable rural development (Lipatova et al., 2021; Hossain et al., 2023). Enterprises in rural contexts often address problems such as youth outmigration, underemployment, and access to basic services.

Digital competencies and entrepreneurship are often recognised as strategic aspects for rural development, but there is limited empirical research on their synergies (Kozma et al., 2021). Few studies have explored how digital

tools can enhance the capacity for entrepreneurship in rural surrounding, or how educational training that combines both elements can shape the aspirations and behaviours of rural youth (Haugen et al., 2022). Moreover, the literature suggests that educational interventions in rural areas often lack contextual adaptation, flexibility, and long-term sustainability (Astro & Yasui, 2017; Barrera et al., 2017).

In response to these gaps, microcredentials have emerged as an innovative educational model. Their modular structure and digital delivery make them particularly suited for populations with limited access to conventional education systems (Wheelahan & Moodie, 2021; Oliver 2019). The integration of microcredentials into lifelong learning strategies is increasingly promoted by European policy frameworks, especially in the context of the Digital Education Action Plan and the European Skills Agenda (European Commission 2020; Cedefop 2021).

In the article the authors examine how microcredential-based training can develop digital and entrepreneurship competencies among rural young people. The study investigates how such training influences young people's professional development. Through a mixed-methods approach involving 200 participants aged 18–30 in rural areas, the research offers new insights into how skill development through innovative educational formats can address rural competences gaps.

By situating the research at the intersection of digital inclusion, rural entrepreneurship, and microcredential-based education, this article contributes to an emerging field of inquiry with significant implications for rural policy, educational design, and youth empowerment.

2. Methodology

The research sample consists of 200 young people aged 18-30 from rural areas across selected regions in Poland. Participants were recruited through local youth organisations, educational institutions, and community networks. The inclusion criteria required that participants be at the early stages of their professional careers and have limited prior exposure to structured entrepreneurial or digital training.

The steps of the research methodology were the following:

Step 1: Pre-assessment – participants completed a structured pre-test questionnaire designed to assess basic knowledge of digital tools and related concepts related to the proposed educational training. In order to assess their knowledge, the authors used a 4-point Likert scale. This pre-assessment provided data for comparison with post-training results and allowed identification of competence gaps.

Step 2: Participation in Microcredential Training Programme – participants completed twelve (12) training microcredentials designed in upskillingRural project[1]. The microcredentials covered the following topics:

- M1 – Digital Skills Apps and Tools for Rural Tourism;
- M2 – Digital Skills for Employment;
- M3 – Green Skills;
- M4 – Circular Economy;
- M5 – Employability in Rural Tourism Entrepreneurship;
- M6 – Social Entrepreneurship;
- M7 – Community Engagement & Involvement;
- M8 – Building Long Lasting Networks and Relationships;
- M9 – Internationalization / Foreign Clients;
- M10 – Marketing;
- M11 – e-Marketing -Video based Content;
- M12 – e-Marketing using AI & Metaverse Spaces.

Each microcredentials included PPT presentations, and interactive exercises.

Step 3: Post-assessment (Post-test) – following completion of the proposed training, participants completed a post-test identical in structure to the pre-test. This enabled a direct comparison of knowledge and self-assessed competency levels before and after training, providing a quantitative measure of learning outcomes.

[1] *Transformative change and ensuring sufficient access to learning opportunities for youth of rural areas* (upskillingRural), 2023-2026, No 2023-1-PL01-KA220-YOU-000150982 (Erasmus+ programme).

Step 4: Evaluation of Module Effectiveness – to assess the quality and usefulness of each microcredential, participants rated all twelve microcredentials using five evaluation criteria:

- C1 – Practical applicability and everyday relevance (weight: 0.25);
- C2 – Adaptation to local needs and context (weight: 0.15);
- C3 – Innovation and use of technology (weight: 0.15);
- C4 – Accessibility and learning flexibility (weight: 0.20);
- C5 – Increasing self-confidence and initiative-taking abilities (weight: 0.25).

In order to establish the weights for the criteria, the AHP method was previously used. This methodological approach enables the delineation of crucial elements when selecting criteria. AHP's structured framework, hierarchical representation, pairwise comparisons, mathematical consistency, flexibility, adaptability, and sensitivity analysis capabilities render it a highly apt method for hierarchisation in decision-making processes across diverse domains, including project management, resource allocation, risk assessment, and strategic planning.

Step 5: Weighted Sum Approach (WSA) Analysis – to aggregate the multi-criteria ratings and generate an overall effectiveness score for each microcredential, the Weighted Sum Approach (WSA) method was applied. For each microcredential, the mean score obtained for each criterion was multiplied by the criterion's assigned weight. These weighted scores were then summed to produce a composite score, which formed the basis for ranking the microcredentials. This method allowed a balanced integration of learner perceptions across multiple dimensions, highlighting which microcredential were perceived most impactful from the learners' perspective.

3. Research Results and Discussion

Step 1 and Step 3 concerned the completion of the questionnaire (Tables 1, 2, and 3). The participants responded the questions in the scale 1-5, where 1 means I totally disagree, and 5 – I totally agree.

The questionnaire was divided into three (3) sections: digital competences, green & entrepreneurial competences, and attitudes.

Table 1: Section A – Digital Competences

No	Statement	Average PRE	Average POST	Difference	% Change
A1	I can use digital applications and tools relevant to rural tourism.	2.7	4.2	1.5	55.6%
A2	I am familiar with tools for online collaboration (e.g., Zoom, Teams).	3.0	4.3	1.3	43.3%
A3	I can use social media for promotional purposes.	2.9	4.4	1.5	51.7%
A4	I know the basics of creating video content.	2.4	4.0	1.6	66.7%
A5	I can identify a target audience and match marketing channels.	2.6	4.1	1.5	57.7%
A6	I am familiar with basic AI tools in e-marketing.	2.1	3.9	1.8	85.7%
A7	I understand the concept of the 'metaverse' and its use in marketing.	1.9	3.5	1.6	84.2%
A8	I can independently create a simple online promotional campaign.	2.5	4.0	1.5	60.0%
Average result		2.51	4.05	1.54	61.4%

Source: Authors.

Table 2: Section B – Green & Entrepreneurial Competences

No	Statement	Average PRE	Average POST	Difference	% Change
B1	I understand the concept of circular economy.	2.6	4.0	1.4	53.8%
B2	I can identify specific green actions.	2.8	4.2	1.4	50.0%

No	Statement	Average PRE	Average POST	Difference	% Change
B3	I know the basics of social entrepreneurship.	2.4	4.1	1.7	70.8%
B4	I can describe the structure and ethics of a social enterprise.	2.3	4.0	1.7	73.9%
B5	I am aware of employment opportunities in rural tourism.	3.0	4.3	1.3	43.3%
B6	I feel confident in planning business initiatives in rural areas.	2.5	4.1	1.6	64.0%
B7	I can establish and maintain professional relationships.	2.9	4.3	1.4	48.3%
B8	I know how to engage the local community.	2.7	4.2	1.5	55.6%
B9	I feel prepared to work with international clients.	2.8	4.2	1.4	50.0%
Average result		2.67	4.16	1.49	55.8%

Source: Authors.

Table 3: Section C – Attitudes

No	Statement	Average PRE	Average POST	Difference	% Change
C1	I feel confident using new technologies for work and learning.	3.0	4.4	1.4	46.7%
C2	I feel ready to take initiative in my local community.	2.9	4.2	1.3	44.8%
C3	I know where to look for further training in digital skills.	2.7	4.0	1.3	48.1%
Average result		2.87	4.2	1.33	46.3%

Source: Authors.

The analysis of the pre- and post-training assessment results among 200 participants shows a clear improvement across all measured areas. The evaluation was divided into three main sections: Digital Competences (Section A), Green & Entrepreneurial Competences (Section B), and Attitudes (Section C).

In Section A – *Digital Competences*, the average score before the training was 2.51, while the post-training average rose to 4.05, representing an increase of 61.4%. Participants showed the most significant gains in their familiarity with artificial intelligence tools used in e-marketing and in understanding the marketing potential of the metaverse, both exceeding 80% improvement. Competences related to social media, video content creation, and identifying appropriate marketing channels also saw notable increases, indicating enhanced readiness to use digital tools effectively in the rural tourism sector.

Section B – *Green & Entrepreneurial Competences* also indicated strong improvement. The average pre-training score was 2.67, increasing to 4.16 after the training, which reflects a 55.8% growth. Participants particularly strengthened their understanding of social entrepreneurship and the ethical foundations of social enterprises, with gains of over 70%. They also improved their ability to plan rural business initiatives, identify green practices, and recognise employment opportunities within the rural tourism industry.

In Section C – *Attitudes*, participants' confidence and motivation increased significantly, with the average score rising from 2.87 to 4.20 – an improvement of 46.3%. They reported feeling more confident in using new technologies, more prepared to take initiative in their communities, and more aware of where to seek further digital competences development.

To sum up, the proposed educational programme was highly effective, leading to marked increases in knowledge, practical competences, and confidence levels. The most significant progress was noted in digital literacy and approaches to marketing, but improvements were evident in every category. These results suggest that the program successfully enhanced participants' capabilities for active engagement in rural tourism development.

The next step was the assessment of the usability, the friendliness and the clarity of the microcredentials taking into account the proposed criteria. The WSA method involved multiplying the average score of each microcredential for a given criterion by that criterion's predetermined weight. These weighted scores were then summed across all five criteria to generate a final composite score for each microcredential. This approach allowed the authors to account for both the importance of different evaluation aspects and the perceived performance of each microcredential against those aspects. The resulting weighted totals enabled a robust, transparent ranking of the modules, reflecting a balanced consideration of multiple factors influencing participant preferences. By using WSA, the authors ensured that the final rankings were not skewed by any single criterion, but rather represented a comprehensive assessment aligned with stakeholder priorities.

The assessment of each microcredential considering the indicated criteria is presented in Figure 1.

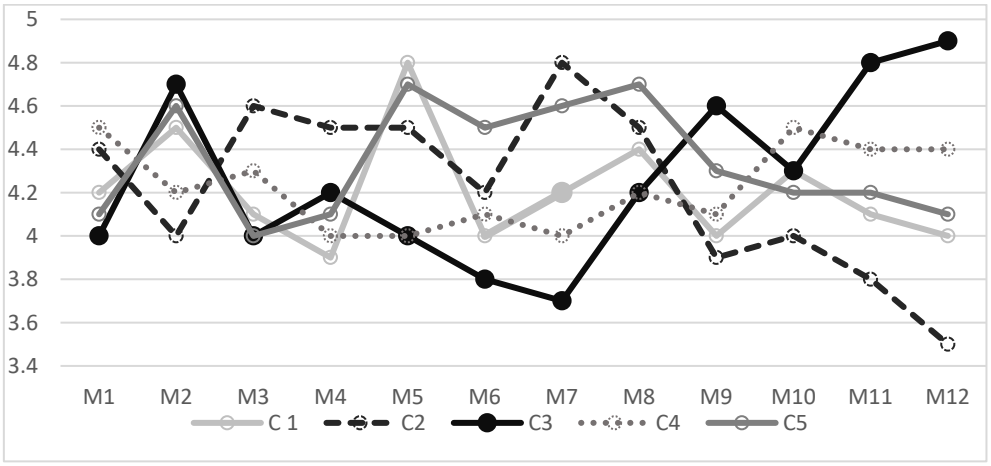


Figure 1: The assessment of the microcredentials using WSA method

Source: Authors.

In order to calculate the final result, the following quota was used:

$$\text{Result} = \Sigma \text{ (average assessment} \times \text{weight)}$$

The results are indicated in Figure 2.

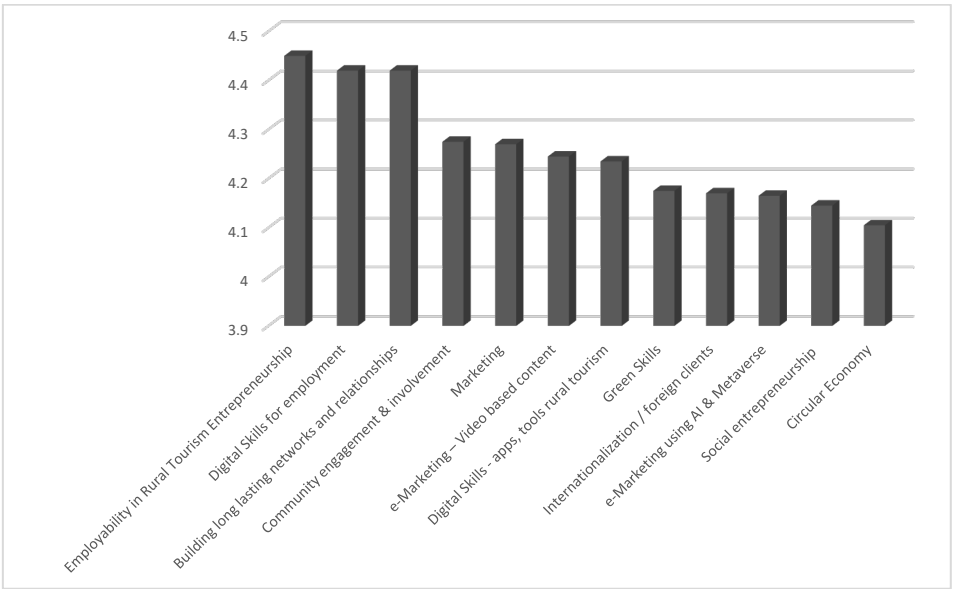


Figure 2: Final results of the comparison

Source: Authors.

Based on the evaluation conducted by the participants, the top-rated module was *'Employability in Rural Tourism Entrepreneurship'.* This microcredential was chosen for its strong practical relevance and alignment with

local needs, especially in rural contexts where tourism offers a viable and sustainable economic opportunity. Participants appreciated that it provides concrete tools for launching and managing entrepreneurial ventures, empowering them to become self-reliant. Moreover, it scored highly in enhancing self-confidence and initiative-taking, which are essential attributes for aspiring entrepreneurs operating in local tourism sectors.

The second place was adjusted to *'Digital Skills for Employment'*, which resonated strongly with participants due to its practical utility and modern content. In a rapidly digitalising world, acquiring competences in digital tools significantly improves employment opportunities. The microcredential's strength lies in its innovative educational programme, its flexibility in learning formats, and its focus on real-world applicability, which together contributed to high scores across multiple criteria.

The same score was achieved by *'Building Long Lasting Networks and Relationships'*, a microcredential that addresses the importance of social capital in both professional and community contexts. Participants valued its emphasis on relationship-building, collaboration, and communication skills – competencies that are important in both entrepreneurship and project-based work. The microcredential's ability to foster confidence and long-term engagement through strategic networking was a key reason for its high evaluation.

The fourth place was taken by *'Community Engagement and Involvement'*, a microcredential closely related to local empowerment. Participants recognised its relevance to rural community development, noting that it encourages them to take an active role in shaping their environment. It was especially well-rated for how it adapts to local needs and contexts, as well as for building a sense of responsibility and encouraging initiatives.

On the other hand, at the end of the ranking the authors identified *'Circular Economy'* microcredential that received the fewest points among all the evaluated microcredentials. Although the topic is highly relevant in the context of sustainability and green transformation, participants perceived the microcredential as abstract and less directly applicable to their immediate needs. The practical utility of the content was rated lower, possibly because the circular economy is a complex concept that may require more contextualisation or examples tailored to rural settings. While its alignment with local and global sustainability goals is acknowledged, participants may have struggled to see how to implement these ideas in their own environments without clearer guidance or case studies.

Just above the aforementioned microcredential, the authors identified 'Social Entrepreneurship' microcredential that also received a relatively low score. It addresses important foundational knowledge, but it was likely viewed as too theoretical and conceptual, lacking the level of hands-on application that many participants were looking for. While topics such as ethics and organisational structure are valuable, participants may have preferred a stronger focus on practical steps, tools, or success stories that show how social entrepreneurship is actually carried out in rural or local contexts. Additionally, it may not have scored as high in the *'Innovation and Use of Technology'* criterion, which was a differentiator for higher-ranked modules.

The third lowest-ranked microcredential, *'e-Marketing using AI & Metaverse spaces'*, also presented a paradox. Although it was rated highly in terms of innovation and technological advancement, its overall score suffered due to limited perceived accessibility and practical relevance to metaverse spaces. For many participants, especially those in rural areas with limited digital infrastructure, the concepts of AI-driven marketing or the metaverse may have seemed too far or disconnected from current capabilities. Despite its cutting-edge content, the microcredential may have lacked enough real-world examples or simplified explanations to make it approachable and useful in their specific contexts.

4. Conclusions

Microcredentials-based training has demonstrated a significant and positive impact on enhancing digital competences among young people living in rural areas. These short, focused, and practical learning experiences are particularly well-suited to the needs of rural youth, who often face barriers such as limited access to traditional education, digital infrastructure, or professional development opportunities.

Through proposed microcredentials, participants gained essential competencies in using digital tools, navigating online work environments, and applying technology to everyday tasks and job-related activities. The flexibility of microcredential formats – including online and hybrid options – was especially beneficial in overcoming geographical limitations and allowed learners to progress at their own pace.

Furthermore, the proposed upskillingRural training fostered not only technical skills, but also broader digital literacy, which is critical for increasing employability and participation in the digital economy. Young people

reported feeling more confident in using technology for communication, problem-solving, and accessing information, which in turn opened up new opportunities for remote work, online entrepreneurship, and digital collaboration.

Importantly, the relevance and practical nature of the content made the learning experience more engaging and immediately applicable. Participants appreciated the real-world orientation of the microcredentials, which helped bridge the gap between abstract digital concepts and their actual use in rural work environments or community projects.

In conclusion, upskillingRural microcredentials-based training serves as an effective and inclusive tool for equipping rural youth with digital competences that are essential for modern employment and community engagement. By combining flexibility, relevance, and practical application, these programmes empower young people to take an active role in the digital transformation of their local areas. The results suggest that participants prioritise practicality, clarity, and personal empowerment in their educational experiences. Microcredentials that bridge theory with practice, and which are adapted to the participants' local context, were clearly more appreciated. This highlights the importance of designing educational content that not only introduces innovative ideas but also ensures that these ideas are tangible, inclusive, and grounded in the participants' everyday realities.

Future research in this area could focus on longitudinal studies that track the actual impact of these educational modules on participants' career development, entrepreneurship success, and community involvement over time. Such studies would help determine whether the microcredentials that received high evaluations in this short-term assessment genuinely lead to measurable outcomes, such as increased employment rates, successful business launches, or greater civic participation in rural areas. Additionally, integrating qualitative methods, such as interviews or focus groups, could provide deeper insight into the personal experiences and perceived value of the training from the learners' perspectives.

Another area of investigation is the adaptability and scalability of these microcredentials across different rural regions or cultural contexts. Researchers could explore how microcredentials need to be adjusted to better fit diverse local realities, infrastructure limitations, or socio-economic conditions. This would also open opportunities to assess the role of digital inclusion and accessibility, especially in relation to advanced topics such as AI and the metaverse, which currently may be beyond the reach of some rural learners but hold future potential.

Finally, future studies might examine educator preparedness and instructional design – investigating how trainers deliver these microcredentials and what support they need to effectively engage rural learners. By linking learner outcomes with pedagogical strategies, research can contribute to the development of more evidence-based, learner-centred educational curricula that bridge innovation with accessibility and empower participants in meaningful, lasting ways.

One limitation of this study is the short-term nature of the evaluation, which does not allow for assessing the long-term impact on employment or business creation. Additionally, the self-reported nature of the questionnaire may introduce bias, and the sample may not be representative of all rural youth demographics.

Ethics Statement

Ethical approvals have been obtained with precautions taken to ensure participants' informed consent and confidentiality.

AI Statement

The authors state that Artificial Intelligence tool was not used in this study.

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Signalling vs. Support: The Strategic Design of Start-up Accelerators

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Abstract: Start-up accelerators play an important role in providing resources to new ventures through mentoring, education, peer interaction, certification, networking, and (in-kind) financing. Numerous studies have described different design choices of accelerators and empirically evaluated their effectiveness on start-up performance, e.g., revenue growth and funding success. However, the determinants and strategies shaping an accelerator's design have been underexplored, as existing studies predominantly treat the design as exogenous. This paper addresses this gap by developing a formal model that conceptualises accelerator design as an endogenous, strategic response to environmental parameters such as the quality and number of applying ventures. The model considers an accelerator that selects a cohort from a pool of heterogeneous start-ups with unobservable quality and supports the selected start-ups through training. The accelerator can exert effort to improve the precision of noisy quality signals (screening) and allocate resources to post-entry support to selected ventures. Both activities incur costs and are constrained by a fixed budget. The accelerator maximises the expected post-program cohort quality, taking into account the trade-off between improving selection accuracy (which increases the perceived quality of start-ups through signalling) and directly supporting selected start-ups (which directly improves the quality of participants), yielding closed-form expressions for the optimal accelerator design. Solving the model for the Subgame Perfect Bayesian Equilibrium, we show that the optimal design critically depends on the entrepreneurial context, such as the share of high-quality start-ups and the selectiveness of the program (cohort size relative to applicant pool size). We find that when high-quality applicants are scarce, screening effort declines and more resources are allocated to post-entry support, as the returns to screening are relatively low. Conversely, the model shows that as program selectiveness increases, accelerators invest more in screening to extract maximum value from limited cohort slots. These comparative statics yield empirically testable predictions and offer practical implications for accelerator managers, suggesting that design should adapt dynamically to changes in the applicant pool and program maturity. The paper contributes to the accelerator literature by providing a strategic explanation for observed variation in program design and resulting effectiveness. Thus, it lays a foundation for future theoretical extensions and empirical validation aimed at refining our understanding of entrepreneurship support organisations.

Keywords: Accelerator, Start-ups, Strategic Resource Allocation, Signalling, Entrepreneurship Support Organisation, Incubator

1. Introduction

Accelerators are important entrepreneurial support organisations that provide start-ups with a range of resources through a structured, cohort-based program over a fixed time period (Cohen and Hochberg, 2014) to help them overcome constraints of their environment (Amezcua et al., 2013; Bergman and McMullen, 2022). Accelerators are a growing phenomenon with over 6,500 programs globally (Dealroom, 2025). Reflecting this growing relevance, research on accelerators has concentrated around two themes: First, various papers focus on empirically assessing the effectiveness of accelerators on venture outcomes such as revenue growth and investment attraction, producing a broad spectrum of empirical results ranging from large positive effects on start-up performance (Gonzalez-Uribe and Reyes, 2021), to the modest positive impact (Assenova and Amit, 2024; Gonzalez-Uribe and Leatherbee, 2018; Hallen et al., 2023), to no effect (Cusolito et al., 2021; Lall et al., 2020), and even a negative impact (Yu, 2019). In parallel, a second research stream has focused on conceptualising the design characteristics of accelerators and identifying the mechanisms how accelerators support start-ups partly explaining heterogeneity in the above outcomes (Cohen et al., 2019; Hallen et al., 2020). Such mechanisms include capacity building through training, network expansion, (in-kind) financing, and certification, often called quality signalling (Avnimelech et al., 2024).

However, despite advances in describing different accelerator designs and conceptualising their impact mechanisms, existing scholarship consistently treats accelerator designs as exogenous, contributing to the "limited theoretical development" (Bergman and McMullen, 2022) within the accelerator literature. As a result, prior studies largely abstract away from analysing the strategies and determinants of the accelerator design. For example, questions on optimal resource allocation remain unaddressed, such as what drives an accelerator to allocate more resources toward sophisticated pre-entry selection procedures—for instance, multi-stage expert interviews and extensive due diligence, as opposed to investing post-entry in support of admitted start-ups through more extensive tailored training and mentorship programs.

Addressing this gap, this paper introduces a formal model to examine the strategic design decision accelerators make between their effort for pre-entry cohort selection versus post-entry support for selected start-ups. Specifically, the model captures the strategic trade-offs reported by accelerator managers by assuming that start-ups vary in latent quality, quality signals received during selection are inherently noisy, and that the effectiveness of post-entry training and support comes at an incremental cost (Hallen et al., 2020). Solving for the equilibrium of this model highlights an important duality: pre-entry selection and post-entry support investments operate as budgetary substitutes, where increased spending on one limits resources for the other, but act as strategic co-determinants of the overall effectiveness of the accelerator on the cohort's venture outcomes.

Further, I show that accelerators strategically adapt their designs to shifting environmental conditions. In particular, accelerators increase their pre-entry selection effort and reduce post-entry support when the applicant pool contains a higher proportion of high-quality ventures, thereby elevating the returns to more rigorous screening, i.e., the chance of identifying high-quality start-ups. By contrast, when the ratio of selected cohort size to total applicants increases, reflecting reduced capacity constraints, accelerators strategically lower pre-entry effort and allocate more resources towards supporting the admitted start-ups directly, because each start-up represents a smaller fraction of the cohort and, hence, reduces the cost of the selection of a low-quality start-up. These endogenously driven differences in design choices lead to differences in the observed effect of the accelerator on venture outcomes and, thus, provide a novel explanation for the heterogeneity of observed design choices and empirical results on accelerators' effectiveness.

The paper contributes to the accelerator literature in multiple dimensions. Theoretically, it advances understanding of how strategic decisions drive accelerator design and the resulting effectiveness. Empirically, our model generates clear, testable predictions that future research can empirically validate, thereby refining insights into the interplay between accelerator environments and strategic design choices. Practically, I offer actionable guidance for accelerator managers on optimising resource allocation decisions in response to changes in applicant pool characteristics and other environmental dynamics.

The remainder of the paper is structured as follows: Section 2 introduces the formal model. Section 3 presents the analyses of the model, including comparative statics analyses. Finally, Section 4 discusses the theoretical and practical implications of our findings and outlines avenues for future research.

2. The Formal Model

This paper develops a stylized but analytically tractable model of how start-up accelerators strategically allocate limited resources between two core functions: (i) pre-entry screening, which aims to reduce information asymmetries via more precise signals on applicants' quality, and (ii) post-entry support (e.g., training, networking, financing), which enhances the actual capabilities and quality of selected start-ups.

The model builds on the idea that start-up quality is initially private information, and external actors—especially investors—do not directly observe a start-up's type. Instead, they observe whether a start-up was accepted by the accelerator. This introduces an important signalling function: the accelerator selection acts as a certification mechanism that reduces adverse selection and enables subsequent success, e.g., financing from investors, new customer relations. Crucially, this quality signal is not exogenous but the result of a costly effort by the accelerator to identify high-quality ventures. On the other hand, accelerators also provide post-selection support that directly increases start-ups' quality. Examples include mentorship, access to financing networks, business development training, or technical assistance. These investments improve actual start-up capabilities and hence increase the post-accelerator quality of the cohort.

We model the accelerator as facing a strategic trade-off between investing in better screening (which enhances the perceived quality of the accepted cohort via more precise signal-based selection) versus investing in more post-entry support (which directly increases the quality of selected ventures regardless of their initial type). The optimal balance depends on structural parameters such as the size of the applicant pool, the share of high-quality applicants, and the desired cohort size.

Start-up types and signalling technology. More formally, we consider an accelerator that receives applications from n start-ups. Each start-up has a quality which is binary and privately known to the start-up. There are high-quality start-ups (H) which have true quality 1, while low-quality start-ups (L) have quality 0. The accelerator knows the share of high-quality start-ups across the population of applicants α similar to knowing the average quality of start-ups in its environment (Chowdhury et al., 2019). To reduce informational asymmetries, the

accelerator can exert screening effort $e \in [0,1]$ to generate a noisy signal about each start-up's quality. High-quality start-ups always produce a positive signal, denoted S_H, while low-quality start-ups generate a positive signal with probability $1 - e$, and a negative signal S_L with probability e. Hence, higher values of e indicate more precise screening, reducing the false positive rate, e.g., through more intensive in-person interviewing of start-ups. The selection process, such as review of written applications or conducting interviews, typically has limited economies of scale and, hence, is assumed to be linear.

Post-entry support and budget. After screening, the accelerator selects c start-ups for its cohort. The accelerator allocates support magnitude s to each selected start-up. Post-entry support increases the quality of each start-up additionally by s, regardless of initial type. The total budget b must cover both the cost of pre-entry screening all applicants and the cost of post-entry support for the admitted cohort. Formally, the budget constraint is given by $b = n \cdot e + c \cdot s$, viewing both e and s in monetary terms. Here, b, c and n are assumed to be exogenous, e.g., defined prior to the budget allocation by the sponsor.

Accelerator's objective. The accelerator's objective is to maximise the total post-program quality of its selected cohort, defined as the sum of the initial quality of selected start-ups plus the additive benefit of support.

Timing. The timing of the game is as follows:

1. Type realisation and applications: Each start-up is randomly assigned a type H or L by nature and n start-ups apply to the accelerator. Note that the order of this does not influence the game as start-ups do not act strategically here (e.g. implicitly assuming application costs for the accelerator are 0).
2. Pre-entry screening: The accelerator chooses the screening effort e, paying cost $n \cdot e$. Each start-up generates a signal conditional on its type.
3. Selection: Based on observed signals, the accelerator selects c start-ups into the cohort.
4. Post-entry support: The accelerator chooses the level of post-entry support s, paying $s \cdot c$, in line with its budget constraint.

3. Analysis

3.1 Equilibrium Characterisation

The accelerator's optimisation problem is solved via backward induction. The equilibrium is a Subgame Perfect Bayesian Equilibrium entailing sequentially rational strategies and belief updating consistent with Bayes' rule given the stochastic signal process.

Stage 3: Post-entry support. Given the screening effort e, the accelerator optimally allocates the entire remaining budget across the c selected start-ups, yielding support intensity $s^*(e) = \frac{b - n \cdot e}{c}$. This is optimal because the accelerator aims to increase the total post-acceleration quality of selected start-ups and has no incentive to not spend its budget.

Stage 2: Selection. High-quality start-ups always produce a positive signal, while low-quality start-ups do so with probability $1 - e$. Hence, the expected fraction of high-quality start-ups among those with a positive signal is: $f(e) = \frac{a}{1-(1-a) \cdot e}$ which respectively is also the expected quality of a start-up with signal S_H. For the accelerator, it is always preferable to select a start-up with a signal S_H having expected quality $f(e)$ over one with signal S_L having quality 0, as subsequent support effectiveness is independent of start-up's quality. Hence, if the number of start-ups with a positive signal exceeds c, the accelerator randomly selects c from this pool. Otherwise, it supplements the cohort with start-ups that received a negative signal. Subsequently, we restrict our attention to the case where there are sufficient start-ups yielding a high-quality signal in expectation, formally assuming $a \cdot n + (1 - a) \cdot n \cdot (1 - e) \geq c$, which seems realistic considering that Assenova & Amit (2024)'s sample of +350 accelerators contains roughly twice as many start-ups with positive signals as capacity on average.

Stage 1: Pre-entry screening. The accelerator maximises the post-acceleration cohort quality. $Q(e)$, which includes the pre-entry quality $f(e)$ and received support $s^*(e)$ for all selected start-ups by choosing the screening effort e:

$$max_e \, Q(e) = c \cdot \big(f(e) + s^*(e)\big) = c \cdot \left(\frac{a}{1 - (1 - a)\ e} + \frac{b - n\, e}{c}\right)$$

Intuitively, the accelerator faces a trade-off between increasing the pre-entry quality through higher screening effort and increasing post-entry quality through direct support of selected start-ups. Notably, the mechanisms

through which start-ups benefit from acceleration are markedly different: With higher pre-entry screening, start-ups benefit from higher quality signals through certification to the outside world, e.g., investors. While with higher post-entry support, start-ups directly benefit from measures improving their quality, e.g., training.

Formally, differentiating with respect to e, the first-order condition is:

$$-n + \frac{ca(1-a)}{[1-(1-a)e]^2} = 0$$

Hence, in an interior equilibrium solution the optimal pre-entry screening effort $e^*$is:

$$e^* = \frac{1 - \sqrt{\frac{ca(1-a)}{n}}}{1-a}$$

However, this expression may lie outside the feasible interval $[0,1]$ in which case, the solution reaches a corner. These corner solutions offer meaningful economic interpretation. If the applicant pool is very large relative to the cohort size and the share of high-quality start-ups is modest, screening becomes prohibitively expensive. In this case, the marginal return to effort is low, since few high-potential start-ups exist to identify, and the marginal cost is high, as screening must be applied to many applicants. The accelerator then optimally sets $e^* = 0$, allocating the full budget to post-entry support. Formally, this occurs when $a(1-a) \leq \frac{n}{c}$.

Conversely, the optimal solution reaches the upper boundary $e^* = 1$ when the unconstrained solution exceeds 1. This occurs when $\frac{1-a}{a} \leq \frac{n}{c}$. This means that the accelerator screens maximally when the share of high-quality applicants is sufficiently large relative to its selectiveness: a small cohort drawn from a strong pool justifies extensive screening to extract top performers. For intermediate values of n, c, and a the interior solution applies.

3.2 Comparative Statics

We now perform comparative statics to examine how the accelerator's optimal screening intensity e^* in an interior solution varies with two critical parameters: (1) the selectiveness of the accelerator, measured as the cohort-to-applicant ratio $\gamma = \frac{c}{n}$, and (2) the prior share of high-quality start-ups a in the applicant pool. Using γ, the optimal screening intensity rewrites to $e^* = \frac{1-\sqrt{\gamma a(1-a)}}{1-a}$.

First, we examine how selectiveness affects optimal screening taking the derivative of e^* with respect to selectiveness γ:

$$\frac{\partial e^*}{\partial y} = -\frac{1}{2(1-a)} \cdot \frac{a(1-a)}{\sqrt{y\,a(1-a)}} = -\frac{1}{2} \cdot \frac{\sqrt{a(1-a)}}{(1-a)\sqrt{y}}$$

Since all terms $a, \gamma \in (0,1)$ are strictly positive, the derivative clearly is strictly negative $\frac{\partial e^*}{\partial y} < 0$. Hence, the screening effort strictly decreases with higher γ (implying lower selectiveness). When the accelerator has a higher cohort size relative to the applicant pool (lower selectiveness through larger γ), the marginal harm of admitting a false positive decreases. Each admitted start-up is less costly in terms of the opportunity cost of a cohort slot, thus reducing the incentive for rigorous screening and instead increasing the incentive to invest in post-entry support. Conversely, a more selective accelerator (lower γ) intensifies its screening effort, since each false positive now represents a more significant loss of scarce cohort capacity.

Second, we examine how changes in prior quality a affect optimal screening. Differentiating the

optimal effort $e^*(y, a)$ with respect to a yields after refactoring:

$$\frac{\partial e^*}{\partial a} = \frac{2\sqrt{y\,a\,(1-a)} - y\,(1-a)}{(1-a)^2}$$

Since the denominator is always positive for $a \in (0,1)$, the sign of the derivative is determined by the numerator. Rearranging this condition yields a clear threshold:

$$\frac{\partial e^*}{\partial a} > 0 \quad \Leftrightarrow \quad a > \frac{\gamma}{\gamma + 4},$$

$$\frac{\partial e^*}{\partial a} < 0 \quad \Leftrightarrow \quad a < \frac{\gamma}{\gamma + 4}.$$

These conditions reflect the following intuition: When the share of high-quality applicants is very low, the marginal benefit from screening—stemming from identifying additional high-quality start-ups and excluding low-quality ones—is initially small and thus remains below the constant marginal cost of screening, that is the opportunity cost of investing the money instead in post-entry support. As a consequence, optimal screening declines further as applicant quality improves slightly, since the net payoff remains negative. However, as applicant quality surpasses a critical threshold (determined by program selectiveness), the marginal benefit from identifying additional high-quality start-ups rises above the constant marginal cost as the chance of identifying additional high-quality start-ups and excluding low-quality ones increases. Beyond this point, the accelerator optimally increases screening effort, as each additional unit of effort now yields a positive net return. Eventually, as screening effort reaches its natural maximum, the optimal effort levels off. This interplay—low marginal benefit at very low applicant quality, rising marginal benefit beyond a critical threshold, and eventual flattening as effort hits its maximum—generates a U-shaped pattern of optimal screening effort in response to changes in applicant quality. Due to space constraints, we restrict our attention to the formal comparative statics with respect to selection effort. In the next section, we highlight some intuition with regards to the comparative statics with respect to post-entry support.

3.3 Numerical Illustration of Equilibrium

To visualize the accelerator's equilibrium behaviour, Figure 1 provides a numerical illustration of the comparative statics derived above. The two panels show how optimal screening effort e^* and post-entry support s^* jointly respond to variation in (a) the selectiveness of the accelerator, γ, and (b) the share a of high-quality start-ups in the applicant pool. These simulations illustrate the closed-form results by highlighting how the trade-off between screening and support unfolds in equilibrium under different environmental conditions.

Panel (a) varies selectiveness by increasing cohort size c, holding the number of applicants fixed. The prior share of high-quality start-ups is set to a relatively low value of $a = 0.05$, reflecting an ecosystem where few high-potential ventures are present. As selectiveness decreases (i.e., γ increases), the value of screening falls, as predicted and explained in the previous section. While a larger share of the budget is allocated towards post-entry support, the support that one start-up receives s^* also declines because the support is distributed across a larger cohort of start-ups. This pattern illustrates a key insight from the model: when cohort slots are relatively abundant, the accelerator finds it optimal to lower its gatekeeping intensity and invest more in downstream support. This might be particularly relevant for newer accelerators having a lower reputation and not attracting as many applicants (Cohen et al., 2019).

Panel (b) complements this by varying the prior share of high-quality start-ups a while holding selectiveness fixed at $\gamma = 0.2$. The results trace a U-shaped response of screening effort to changes in applicant pool quality, analytically described above. This is accompanied by an inverse-U-shaped support-level for selected start-ups, simply by the changed incentives for selection effort and determined by the budget constraint.

These numerical simulations illustrate how the accelerator's design choices emerge endogenously from trade-offs between information acquisition (via screening) and direct capability-building (via support), and how these choices respond systematically to the characteristics of the applicant pool and the selectiveness of the program.

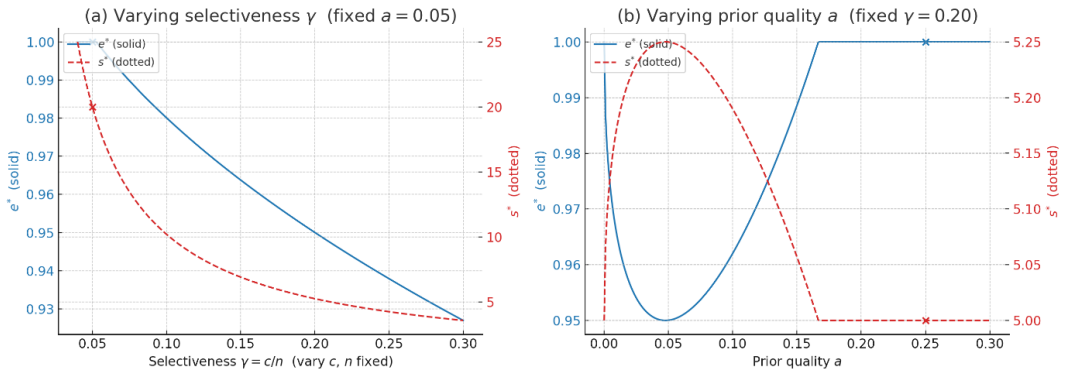


Figure 1: Numerical illustration of equilibrium behaviour of accelerator e^* and $s^*$with (a) varying selectiveness γ and (b) varying prior quality of applicants a

4. Discussion

This paper introduces a formal model examining how start-up accelerators strategically allocate limited resources between pre-entry screening, which influences perceived cohort quality via signalling effects, and post-entry support, which directly enhances the quality of selected ventures. While these two dimensions compete for budgetary resources, they jointly shape overall cohort outcomes. Importantly, the equilibrium accelerator design emerges endogenously, influenced by environmental factors such as accelerator selectiveness and the underlying quality distribution of applicants. This approach provides a theoretical foundation to help explain empirical variations observed in accelerator designs and effectiveness.

By endogenizing accelerator design decisions, this study contributes to the theoretical accelerator literature by explaining how context-specific strategic choices can account for observed differences in practice and outcomes. For example, accelerators operating in environments characterized by predominantly lower-quality ventures may optimally choose to limit their screening efforts, reallocating resources instead toward enhanced post-entry support. In contrast, programs situated within ecosystems with stronger applicant pools and higher selectiveness may achieve greater effectiveness by prioritizing rigorous screening. Thus, variations in observed accelerator characteristics and outcomes may reflect rational strategic adaptation rather than implementation inconsistencies or suboptimal practices. These findings underline the importance of incorporating strategic determinants of accelerator design into future evaluations of their effectiveness, also in the interpretation of empirical results.

From a managerial perspective, the model highlights the importance of adapting accelerator design to the specific characteristics of the operating environment. Rather than identifying a single best-practice configuration, the findings suggest that the optimal allocation between pre-entry screening and post-entry support is contingent on contextual parameters and may shift over time. For instance, in settings where the applicant pool contains relatively few high-quality ventures—such as nascent entrepreneurial ecosystems or newly launched accelerators—greater emphasis on post-entry support may be warranted to build capabilities among selected start-ups. Conversely, when application numbers increase and the program becomes more selective, the marginal value of each cohort slot rises, potentially justifying more intensive investment in pre-entry screening per applicant. These insights underscore the value of a flexible, responsive design approach in accelerator management, aligned with shifts in applicant quality, program maturity, and ecosystem development.

Naturally, this study is subject to limitations arising from model simplifications. To explore these limitations, it is important to complement this research with further theoretical and empirical research. On the theoretical side, incentives of accelerators could be explored in a variety of settings. The accelerator's objective function could be modified to reflect a broader set of strategic goals, such as prioritizing improvements in lower-quality ventures for ecosystem-building accelerators or emphasizing relative rather than absolute improvements in quality for impact-oriented programs. Additionally, explicitly modelling downstream consequences of accelerator decisions—such as investor reactions, financing outcomes, or venture growth trajectories—would provide greater realism. Further research could also examine competitive dynamics among accelerators, endogenous application decisions by entrepreneurs, and reputational effects to illuminate how strategic accelerator design evolves within realistic entrepreneurial ecosystems. Finally, endogenizing additional critical design parameters, such as cohort size, could enhance our understanding of why accelerators differ significantly in their selectivity and how scale interacts strategically with screening and support decisions.

Empirical testing of the comparative static predictions developed here presents another promising direction for future research. Matched datasets linking accelerator decisions, applicant pool characteristics, and subsequent venture outcomes could empirically validate the theoretical propositions advanced in this paper. Such empirical investigations would strengthen the theoretical model's relevance and provide further managerial and policy guidance, clarifying how context-specific strategic resource allocations shape accelerator effectiveness.

Collectively, pursuing these theoretical and empirical avenues can advance scholarly understanding of accelerator strategies, providing deeper insights into the internal trade-offs and external constraints that shape entrepreneurship support organisations.

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Ethics Declaration

No ethical declaration needed for this paper.

AI Declaration

This manuscript benefited from AI-assisted copy editing using OpenAI's ChatGPT-4o. In this context, "AI-assisted copy editing" refers to AI-supported improvements to human-generated text for readability and style, and to ensure accuracy in grammar, spelling, punctuation, and tone. These improvements include wording and formatting changes, but did not involve generative editorial work or autonomous content creation.

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PhD Research Papers

Associations Between Demographic and Socio-Economic Factors and Entrepreneurship in Brunei

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Abstract: This study explores how demographic and socio-economic factors are associated with entrepreneurship in Brunei, drawing on nationally representative data from the Labour Force Survey. Using self-employment as a proxy for entrepreneurial activity, the analysis identifies the key individual-level characteristics associated with entrepreneurship in Brunei. Binary and multinomial logistic regression models were employed to assess predictors such as gender, age, education level, and household income. The findings reveal patterns indicative of necessity-driven entrepreneurship, especially among those with lower incomes and limited education. These insights contribute to a broader understanding of inclusive entrepreneurial dynamics in a small, resource-dependent economy. The study provides evidence-based recommendations to inform future targeted and socially responsive policy interventions. It also underlines the importance of considering demographic and socio-economic differences in the framework of entrepreneurship policies to support broader and more inclusive participation.

Keywords: Entrepreneurship, Self-employment, Socio-economic Factors, Brunei, Inclusion.

1. Introduction

Entrepreneurship plays a key role in stimulating Brunei's economic growth and reducing its dependence on oil and gas. Over the past few years, various entrepreneurship policies and programs have been implemented to encourage participation in the private sector, create employment opportunities, and improve the economy (Siddiqui, 2012; Hamdan and Hoon, 2019; Shahlehi *et al.*, 2020). However, to ensure that the implemented initiatives reach under-represented groups and achieve a meaningful impact, it is important to understand who is likely to venture into entrepreneurship and the factors that drive their participation (Soomro *et al.*, 2019; Silva *et al.*, 2022). To date, only a limited number of studies have examined the characteristics of entrepreneurial participation in Brunei, particularly in identifying who engages in entrepreneurship and whether someone ventures into entrepreneurship out of necessity, such as unemployment or a lack of job options, or out of opportunity, such as seeing market potential or pursuing work freedom. Therefore, this study focuses on the demographic and socio-economic factors associated with participation in self-employment as an indicator of entrepreneurship.

This study uses data from the Brunei Labour Force Survey (LFS) 2020–2021 to examine the association between characteristics such as gender, age, education level, household income, and the likelihood of self-employment. It also assesses transitions in employment status, from paid employment, inactivity, or unemployment to self-employment, as a preliminary indication of whether entrepreneurship may be driven by necessity or opportunity, consistent with previous studies that use such transitions as a proxy for entrepreneurial motivation (Block and Sandner, 2009; Moulton and Scott, 2016). The LFS was selected for this study because it is a nationally representative large-scale data source and provides comprehensive data on the working-age population in Brunei, including self-employment indicators that are widely used in entrepreneurship research and are comparable to international labour force data (Audretsch, 2003; Grilo and Irigoyen, 2006), although the LFS does not directly measure entrepreneurship.

Although the data used do not indicate cause and effect or the actual motivation of individuals, this study indirectly infers the likelihood and patterns of entrepreneurship through analysis of demographic profiles and employment transitions. The analysis was conducted using binary and multinomial logistic regression. This study is part of PhD research that aims to provide insight into who participates in self-employment in Brunei and how these patterns can help understand entrepreneurship, supporting the formation of more inclusive and evidence-based policies.

2. Literature Review

Self-employment is frequently used as a proxy for entrepreneurship due to its consistent availability across national datasets despite its limitations in fully capturing entrepreneurial activity's complexity (Audretsch, 2003; Thurik *et al.*, 2008). While not all self-employed individuals can be considered entrepreneurs in a true sense, self-employment remains a useful proxy, as it encompasses a broad spectrum of both entrepreneurial and non-entrepreneurial activities. This includes individuals who build businesses offering innovative products or services, create value and novelty in the market, and compete to meet consumer needs. However, self-employment also includes less entrepreneurial forms of work, such as independent professionals or small-scale businesses that lack long-term planning or growth-oriented goals. Self-employed individuals often demonstrate key entrepreneurial traits, including opportunity recognition, risk-taking, and resource management (Schumpeter, 1934; Kirzner, 1973; Gartner, 1988; Shane and Venkataraman, 2000). Self-employment is a practical indicator which continues to be widely used in academic literature and national surveys, using similar definitions and available data (such as the Labour Force Survey) to ensure consistent comparisons between countries (Grilo and Irigoyen, 2006; OECD, 2017). Changes in self-employment status also provide insight into whether participation in entrepreneurship is driven by necessity (for example, due to unemployment) or by opportunity (for example, seeing market potential) (Block and Sandner, 2009; Margolis, 2014).

Various studies have shown that gender and age are key factors influencing participation in entrepreneurship. Men are generally more likely to become entrepreneurs than women, who often face additional constraints such as limited access to capital, family responsibilities, and widely accepted cultural expectations (Minniti and Nardone, 2007; Brush *et al.*, 2009; Powell and Eddleston, 2013; Hägg *et al.*, 2023). However, this gender gap is not universal and can vary depending on the socio-cultural context. When it comes to age, younger individuals often exhibit high entrepreneurial intentions (Aydin *et al.*, 2024), but they typically lack the resources or experience to act on these intentions. In contrast, middle-aged individuals tend to have stronger social networks and greater financial stability, increasing their likelihood of starting a business (Bönte *et al.*, 2009; Păunescu *et al.*, 2018).

Education and household income also play critical roles. Higher education is typically associated with opportunity-driven entrepreneurship, as it equips individuals with relevant skills and access to professional networks (Davidsson and Honig, 2003; Nasiri and Hamelin, 2018). On the other hand, those with lower education or income levels are more likely to engage in entrepreneurship as a necessity, often driven by barriers in the formal labour market, such as limited job availability and high education and skills requirements from employers (Thurik *et al.*, 2008; Fields, 2019). While the referenced studies are based on a range of countries, the underlying conceptual relationships, such as between education, income, and the different routes individuals take to become entrepreneurs, remain relevant for Brunei. These frameworks offer a basis for examining patterns in Brunei, where these relationships have not been investigated yet, to help evaluate the country's ongoing efforts to diversify its economy by promoting entrepreneurship. However, empirical studies examining the relationship between these factors and entrepreneurs in Brunei are limited. Several studies, such as those by Low *et al.* (2013) and Musa and Basir (2019) have examined aspects of entrepreneurship, but these studies are qualitative and focus more on individual motivation and challenges, without examining how individual socio-economic factors and household background, such as income, household size, and the occupation of the household head, may affect both participation in entrepreneurship and the type pursued.

Although this study focuses on individual-level factors, previous research has highlighted the importance of broader ecosystem support, including collaboration between government agencies, financial institutions, educational providers, and communities (Stam and Spigel, 2016). This structural dimension is not addressed in detail in this paper, as its analytical focus is on demographic and socio-economic factors using Labour Force Survey (LFS) data.

3. Data and Methods

3.1 Data Source and Sample

This study uses cross-sectional data from the 2020 and 2021 Brunei Labour Force Surveys (LFS). The LFS is a nationally representative survey collected annually, containing demographic and employment information. For LFS 2021, 7,242 respondents aged 15 years and above were included, with 5.5% identified as self-employed. To analyse changes in employment status, the 2020 and 2021 LFS data were matched at the individual level, as both years used the same household sample set due to COVID-19-related constraints that limited the implementation

of new sampling for the LFS in Brunei. Matching was performed using the pseudo-individual identifiers provided in the LFS dataset. This method allows a longitudinal analysis that resembles a panel, providing insights into employment transitions over time. 5,096 individuals (70.4%) were successfully matched: among them, 2.6% transitioned to self-employment from either paid employment or inactivity, 3.4% remained self-employed, and 0.3% transitioned from unemployed to self-employed.

3.2 Dependent Variables

Two main outcome variables are used. The first is a binary variable of self-employment, denoted as 1 for those self-employed. It refers to respondents who self-reported based on their primary employment status in 2021 as own-account workers, either working for themselves or running a business alone or in partnership without paid employees. Not self-employed, denoted as 0, includes employees, employers, domestic helpers, trainees, the unemployed, and those inactive in the labour force. The second variable is the transition between employment states, derived from the 2020 and 2021 LFS data, with cases matched to give changes in employment status over a one-year period. We group the transitions into four categories: paid employment or inactivity to self-employment, remaining self-employed, transition from unemployed to self-employment, and not self-employed in both years.

3.3 Independent Variables

The analysis started with a full set of demographic and socio-economic variables, including gender, age, residential status, education, religion, household income (from both 2020 and 2021 LFS data), other income, district, household size, participation in long-life learning, disability status, willingness to work more hours, and employment background of the household head. To obtain a parsimonious model, only the variables that remained significant after backwards stepwise selection were used in the binary and multinomial logistic regression models. However, the discussion in this paper focuses on only two main factors: education level and household income.

3.4 Analytical Methods

This study used binary logistic regression and multinomial logistic regression. The binary logistic model assesses factors associated with self-employment status in 2021 as the dependent variable is dichotomous (self-employed vs. not self-employed). Multinomial logistic models were used to analyse changes in employment status between 2020 and 2021 for individuals successfully matched in both years. This method was used because it allows comparisons across four transition categories (see section 3.2). However, given the small sample sizes for some categories, they were re-categorised into larger groups to ensure the stability of the estimates.

4. Results

4.1 Associations With Self-employment

All estimates presented are based on regression models that also control for additional variables (see Section 3.3). The findings show that education and household income are significantly associated with the likelihood of self-employment. Individuals with low education (compared to those with secondary education) were more than twice as likely to be self-employed. Similarly, those in the lowest household income group have a 2.4 times higher likelihood of being self-employed than those in the highest income group. Figure 1 shows a forest plot that displays the estimated odds ratios for the main variables discussed here (education and household income) after controlling for other variables in the regression model.

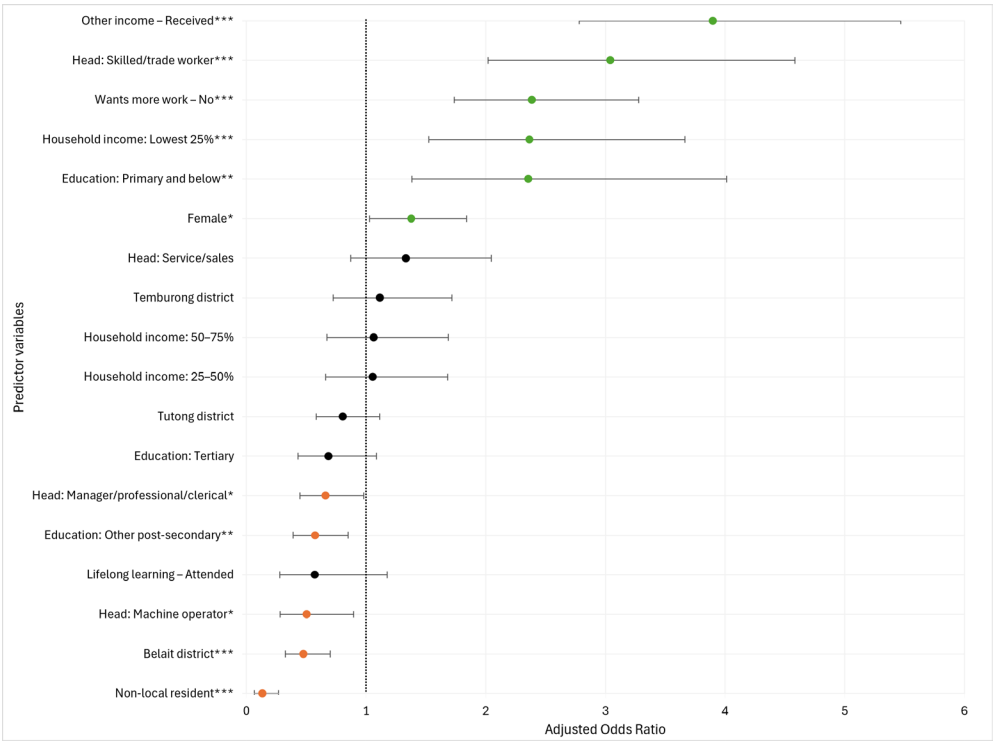


Figure 1: Forest plot of adjusted odds ratios from the full logistic regression model predicting the likelihood of self-employment, based on the 2021 Brunei Labour Force Survey (N = 7,242).

Note: The plot shows adjusted odds ratios (ORs) with 95% confidence intervals. An OR > 1 indicates a higher likelihood of self-employment for a person with that characteristic; an OR < 1 indicates a lower likelihood. Green dots represent statistically significant positive associations, orange dots represent significant negative associations, and black dots are non-significant. Asterisks denote statistical significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The dashed line at OR = 1 marks no association.

4.2 Associations With Transitions to Self-employment

Individuals with lower educational levels were most likely to transition from paid or inactive work to self-employment, with a predicted probability of approximately 6%. In contrast, those with tertiary education were the least likely to transition to self-employment. These differences were statistically significant, particularly between the primary and tertiary groups ($p < 0.001$) and between the secondary and tertiary groups ($p < 0.01$), suggesting that education affects the likelihood of becoming self-employed (Figure 2).

However, the pattern was different when using odds ratios. Individuals with low education had a 99% lower chance of transitioning to self-employment than those with secondary education (OR = 0.010) (Table 1). On the other hand, those with tertiary education were 2.45 times more likely than the reference group, despite having the lowest predicted probability. Thus, the two approaches offer different but complementary perspectives for interpreting the relationship between education and the likelihood of becoming self-employed. While predicted probabilities are estimated by averaging the distribution of other variables in the sample, the odds ratios reflect a relative comparison with the reference group, holding all other variables constant.

In terms of household income, individuals in the lowest 25% income group had the highest predicted probability of remaining self-employed at around 12%, compared to only 5% in the highest income group. This difference was statistically significant ($p < 0.01$), indicating that low-income individuals were more likely to remain self-employed. This odds ratio also supported this finding, where individuals in the lowest 25% group were nearly 10 times more likely to remain self-employed compared to those in the highest income group (OR = 9.585, $p < 0.01$). Meanwhile, for the transition from unemployment to self-employment, individuals in the 50% to 75% income group had twice the chance of becoming self-employed compared to those in the highest income group (OR = 2.00, $p < 0.01$).

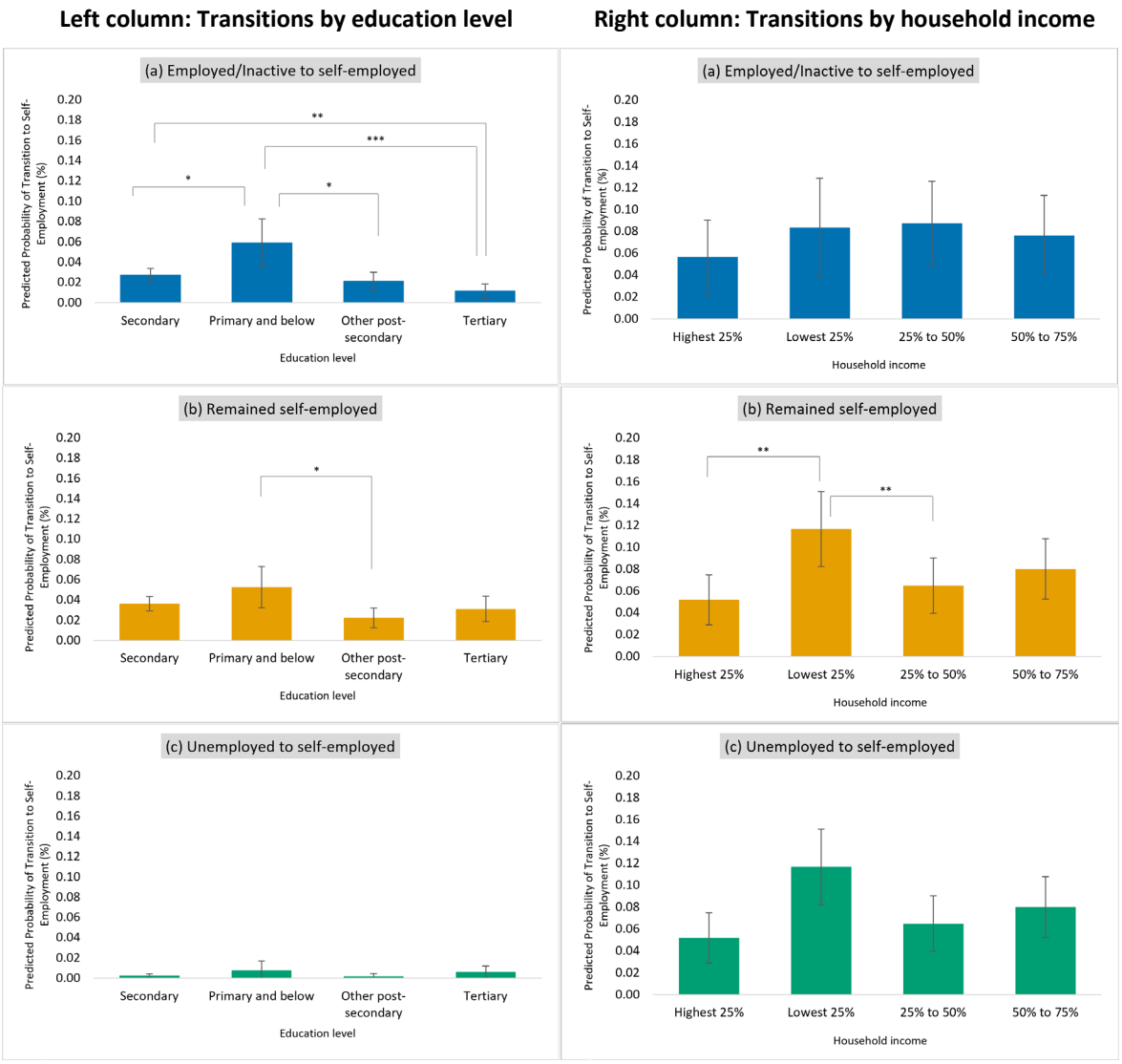


Figure 2: Bar chart showing the predicted probabilities of self-employment transitions by education level and household income group across three transition types: (a) employed/inactive to self-employed, (b) remain self-employed, and (c) unemployed to self-employed.

Note: Estimated marginal mean probabilities were estimated from the fitted multinomial logistic regression model and were computed using the emmeans package in R (Hou *et al.*, 2021; Gabrio *et al.*, 2022). All estimates were calculated by averaging over the observed distribution of the covariates in the dataset, such that the effects of other variables were held constant at their observed proportions in the sample. Error bars represent 95% confidence intervals. Asterisks and horizontal lines above the bars indicate statistically significant pairwise differences between groups, based on comparisons of estimated marginal means. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 1: Multinomial logistic regression results: Odds of transitioning to self-employment by education level and household income group across three transition types.

Explanatory variables	Coefficient (B)	S.E.	p-value	Exp(B) / OR	Coefficient (B)	S.E.	p-value	Exp(B) / OR	Coefficient (B)	S.E.	p-value	Exp(B) / OR
Not self-employed (Base outcome)	Employed/Inactive to self-employed				Remain self-employed				Unemployed to self-employed			

Explanatory variables	Coefficient (B)	S.E.	p-value	Exp(B) / OR	Coefficient (B)	S.E.	p-value	Exp(B) / OR	Coefficient (B)	S.E.	p-value	Exp(B) / OR
Education												
Primary and below	-4.623***	0.286	<0.001	0.010	1.64***	0.180	<0.001	5.154	0.342	0.240	0.155	1.407
Other post-secondary	-6.732***	0.898	<0.001	0.001	1.146	0.595	0.054	3.143	-0.755	0.684	0.270	0.470
Tertiary	0.898***	0.252	<0.001	2.453	0.669*	0.307	0.029	1.952	-1.139*	0.534	0.033	0.320
Secondary (ref)												
Explanatory variables	**Coefficient (B)**	**S.E.**	**p-value**	**Exp(B) / OR**	**Coefficient (B)**	**S.E.**	**p-value**	**Exp(B) / OR**	**Coefficient (B)**	**S.E.**	**p-value**	**Exp(B) / OR**
Not self-employed (Base outcome)	Employed/Inactive to self-employed				Remain self-employed				Unemployed to self-employed			
Household income												
Lowest 25% income group	1.240	0.712	0.081	3.454	2.261**	0.852	0.008	9.585	-0.391	1.063	0.713	0.676
25% to 50% income group	-0.302	0.256	0.238	0.740	0.567	0.303	0.061	1.762	-0.629**	0.214	0.003	0.533
50% to 75% income group	-0.549*	0.253	0.030	0.578	0.339	0.280	0.227	1.402	0.695***	0.202	0.001	2.002
Top 25% income group (ref)												

Note: Asterisks denote significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5. Discussion

5.1 Education and Self-employment in Brunei

The findings demonstrate that individuals with low education are more likely to be self-employed than those with higher education. This pattern aligns with the limited access to formal employment among those with low education in Brunei, as raised by Roberts (2011) and OECD and ERIA (2018). In this context, self-employment is seen more as a response to formal labour market constraints than as an indicator of innovative entrepreneurship. This interpretation is further supported by national statistics, which indicate that 61.1% of the total unemployed in Brunei in 2021 had only secondary education or less (Department of Economic Planning and Statistics, 2021). Such patterns are also consistent with international findings linking self-employment among the less educated to survival-driven motives (Poschke, 2013; Low and Sajnani, 2015; Varghese and George, 2015).

However, the tendency to remain self-employed suggests that it constitutes a major source of income for some groups. Remaining in self-employment may reflect various realities, whether as a survival strategy or a successful venture. This study did not assess the business performance or outcomes. However, staying in self-employment,

particularly among individuals with lower education, often reflects the need to continue earning an income, given the limited options in the formal labour market. Even in small businesses and the informal sector, the ability to remain self-employed has been reported in countries such as Oman, where less-educated individuals continue to be active in the skilled and service sectors (Al Shukaili *et al.*, 2022).

Interestingly, although higher education did not significantly affect the likelihood of being self-employed, the results demonstrated that individuals transitioning from paid employment or inactivity to self-employment were more likely to have a higher level of education. This does not prove causality but suggests that some highly educated individuals may consider self-employment as an alternative career option, especially when the job market changes. This finding is consistent with the argument that high human capital can catalyse entrepreneurial actions when the right opportunity exists (Thurik *et al.*, 2008; Zhang *et al.*, 2022).

5.2 Household Income and Self-employment in Brunei

The findings demonstrate that individuals from low-income households are more likely to be self-employed than those from higher-income groups. This pattern seems to illustrate the role of self-employment as a response to economic stress, which aligns with findings linking necessity-based entrepreneurship among vulnerable groups (Poschke, 2013; Low and Sajnani, 2015). For additional context, household survey data indicate that from 2005 to 2015/16, monthly expenditure and income for the lowest 10% of households increased by an average of 6.7% and 8.4% per year, respectively, while inflation remained relatively low at approximately 5% (Department of Economic Planning and Statistics, 2019; International Monetary Fund, 2025). This suggests real growth in income and spending. Nevertheless, many low-income households still face challenges in meeting basic needs, as indicated by recent studies on poverty and material deprivation in Brunei (Arifin *et al.*, 2024), and thus in this context, self-employment may be a way for some individuals to supplement their income or overcome financial constraints. In this context, self-employment can serve as a means for some individuals to supplement their income or manage financial constraints. Although the expenditure and income data refer to an earlier period, they provide useful background for understanding the longer-term financial conditions faced by low-income households in Brunei.

In addition, this study found that individuals transitioning from unemployment to self-employment were more likely to be from middle-income households (in the third income quartile) based on household income measured before the employment transition. This suggests that a household's financial position, including access to savings, assets, or moral support, may influence a person's ability to realise entrepreneurial aspirations (Hundley, 2006; Molina, 2020).

6. Related Policy Impacts

The findings indicate that low-income and less-educated individuals are more likely to be self-employed, possibly because they are better equipped to overcome financial constraints. While Brunei already provides training and microfinancing initiatives, these may not effectively reach those operating informally or from home-based businesses. Hence, there is a need for more inclusive and accessible programmes that prioritise ease of entry, continuous support, and better outreach to vulnerable groups. For instance, Malaysia's Micro Financing Scheme and eUsahawan initiative (Ridzuan *et al.*, 2020) target underserved groups with digital skills and microloans, while Oman's business development centres offer ongoing mentorship and training for small entrepreneurs (Khan and Almoharby, 2007). These examples demonstrate how entrepreneurship policies can be structured to reach vulnerable groups more effectively, an approach that could be adapted to Brunei's context to better support necessity-driven entrepreneurs. At the same time, the study also found that highly educated individuals, especially those transitioning from employment or inactivity, were also more likely to become self-employed. This suggests that entrepreneurship policies in Brunei should also support opportunity-driven entrepreneurs by promoting innovation, mentorship, and high-growth options.

7. Limitations and Suggestions for Further Research

This study uses two cross-sectional sets of Labour Force Survey (LFS) data for 2020 and 2021, which are linked at the individual level, allowing for a limited longitudinal analysis of employment status transitions. However, the corresponding sample size was limited, and the observational study design allowed for association, not causal, interpretations. A one-year observation period limits our ability to identify long-term patterns or the sustainability of self-employment. Findings based on the 2020–2021 LFS data may also reflect entrepreneurial patterns influenced by the COVID-19 pandemic phase, as well as the initial economic adjustment. Therefore,

future studies should consider using longitudinal data over a longer period to determine the direction of these relationships more accurately.

Another limitation is the use of self-employment as a proxy for entrepreneurship, which may not fully capture the multidimensional nature of entrepreneurial activities.

Additionally, this study did not directly measure the actual motivation of individuals to be self-employed. The interpretation of necessity-based and opportunity-based entrepreneurship is inferred from respondents' socio-economic backgrounds and observed employment transitions. Future studies should incorporate direct measures in the questionnaires or interviews to identify the reasons for choosing self-employment.

8. Conclusions

This study demonstrates that educational level and household income are associated with the tendency to be self-employed in Brunei. Individuals with low educational attainment and those from low-income households are more likely to be self-employed. Simultaneously, individuals with higher education are more likely to transition from paid employment or inactivity to self-employment. Although this study does not establish causality or directly measure motivation, the observed patterns align with findings from previous research that individuals with fewer resources often pursue self-employment out of necessity. In contrast, those with higher skills and qualifications may consider it a strategic or flexible career choice.

This study provides indicative evidence of two distinct self-employment pathways that may warrant different policy responses. Individuals from low-income and less-educated households are more likely to enter and remain self-employed, which may suggest a pattern driven by necessity. In contrast, those with higher education are more likely to transition into self-employment from paid work or inactivity, which may reflect opportunity-driven entrepreneurship. However, the analysis is based on cross-sectional data over a short period and does not capture the underlying motivations behind these patterns. It is also possible that other factors, such as personal preference, flexibility, or informal work norms, may influence these outcomes. Therefore, while the findings suggest potential directions for inclusive and targeted support, further studies using longitudinal and qualitative data are needed better to understand the drivers and nature of self-employment in Brunei.

Ethics Declaration

Ethical approval was obtained from the University of Southampton Research Ethics Committee (ERGO/103771). The study used anonymised secondary data from Brunei's national statistics agency, with no personal identifiers involved.

AI Declaration

No generative AI tools were used to create content or analyse data.

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Signal Formation Cycle and Process: A Single-Case Study of an Intrapreneur

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Abstract: This study aims to explore the cycle and process of signal formation through a single-case study of an intrapreneur, and to examine the potential for generalization. While traditional Signaling Theory has primarily focused on signal types and their effects, this study shifts attention to the formation process of signals—how they are shaped through individual experiences and social interactions. The subject of this study is an intrapreneur who, after working as a musician in London, joined a major Japanese game company and later engaged in business development as an intrapreneur. His cross-cultural and cross-industry experiences make him a suitable case for examining how signals are formed across diverse contexts. Employing a mixed-method approach, Study 1 quantitatively analyzed the vocal signals used in pitch and daily speech, identifying patterns of consistency and expression. Study 2 qualitatively examined how life experiences, social environments, and influential relationships contributed to signal development. The findings reveal that signal formation is a dynamic and continuous process constructed through emotional experiences and interpersonal support. This study contributes to Signaling Theory by shifting the analytical focus from signal effects to formation mechanisms, offering a new lens for understanding strategic communication among intrapreneurs. The originality and value of this study lie in its focus on when and how intrapreneurs acquire signals, and in its exploratory use of a single case to examine whether the underlying factors may be generalizable to other contexts. Signals are constructed through the interaction of internal elements—such as "I AM," "I NEED," "I WANT," "I WILL," and the author's original concept "I HAVE"—and external elements such as the receiver and environment. These signals emerge in recurring cycles throughout one's life, and over time, these cycles accumulate to form a sustained developmental process. Future research should validate these findings through comparative studies involving a broader range of intrapreneurs and entrepreneurs.

Keywords: Intrapreneur Pitch, Signal Formation, Signaling Theory

1. Introduction

The purpose of this study is to clarify how intrapreneurs form signals through their personal experiences and social environments. Traditional Signaling Theory has mainly focused on the types and effects of signals, but the process by which the signaler constructs signals has not been sufficiently explored. This study aims to provide a new perspective by demonstrating that signals are formed dynamically and continuously through the accumulation of experiences over time.

This work consists of two studies. STUDY 1 quantitatively analyzes the vocal characteristics of a Japanese intrapreneur, focusing on differences in speech style between pitch presentations and daily conversations. STUDY 2 qualitatively examines how his life experiences and social influences have contributed to signal formation, using semi-structured interviews and a questionnaire. Finally, the findings from both studies are integrated to systematize the cycle and process of signal formation.

This study focuses on intrapreneurs rather than entrepreneurs. While both pursue innovation and opportunity recognition, entrepreneurs start independent ventures, whereas intrapreneurs operate within existing organizations. Clarifying this distinction is essential, as signal formation may vary by organizational context.

2. Theoretical Background

2.1 Development of Signaling Theory and its Applicability to Intrapreneurship

Signaling Theory (Spence, 1973) explains how individuals and organizations convey trustworthiness and competence under conditions of information asymmetry, and has since been applied across various fields. Spence demonstrated that observable indicators such as educational background serve as signals of an applicant's ability in labor markets, offering a theoretical framework to address problems arising from asymmetric information. In such contexts, where evaluators cannot directly assess the abilities or credibility of signalers (Connelly et al., 2011), signals become essential cues for decision-making (Bergh et al., 2014). Over time, this theory has been extended to strategic decision-making within management and organizational settings. For example, in financial disclosures, reports and forecasts have been identified as signals of credibility for investors (Morris, 1987). Similarly, in mergers and acquisitions or strategic alliances, managerial

communication and prior partnership history act as signals of trustworthiness and legitimacy to the market (Gulati & Higgins, 2003; Rindova et al., 2005).

In the field of entrepreneurship, theoretical and empirical research has advanced our understanding of how entrepreneurs build trust in uncertain environments. For instance, founders' human capital (Ko & McKelvie, 2018), third-party endorsements (Courtney et al., 2016), the frequency and timing of updates in crowdfunding (Block et al., 2018), and pitch delivery and emotional expression have all been shown to function as trust-enhancing signals. Moreover, Shane and Venkataraman (2000) emphasized that entrepreneurs engage in different behaviors across the opportunity recognition, evaluation, and exploitation stages, which serve as context-specific signals contributing to trust formation.

Signals emitted by intrapreneurs and entrepreneurs are crucial channels for conveying credibility, competence, and intent, and take diverse forms. Signals are composed of both verbal and non-verbal elements, strategically deployed and adjusted according to context. For example, vocal tone, speech patterns, intonation, and word choice during pitches or presentations serve as linguistic signals that form clear impressions on evaluators. Meanwhile, non-verbal cues such as posture, eye contact, and gestures often exert even stronger influence than language itself, directly affecting the judgments of recipients (Tsay, 2021). Furthermore, the structure of narratives and the timing of their delivery are integral parts of signaling (Parhankangas & Ehrlich, 2014), through which individuals communicate their values and intentions. Although these signals are rooted in internal characteristics such as creativity and self-efficacy, they are formed in dynamic interaction with organizational cultures and institutional environments. Therefore, intrapreneurial signaling is not merely an expressive act but a strategic and dynamic process of information transmission, selectively adapted to specific situations.

2.2 Dynamic and Contextual Nature of Signal Formation: From "I am" to "I will"

Traditional signaling research has primarily focused on the types and effects of signals, paying insufficient attention to the processes through which signals are formed. Most studies have assumed a static framework composed of the signaler, signal, receiver, and environment (Bafera & Kleinert, 2022), and have analyzed how signals emitted by the signaler influence the receiver's impressions and decision-making (Spence, 1973; Morris, 1987; Gulati & Higgins, 2003; Rindova et al., 2005; Connelly et al., 2011; Courtney et al., 2016; Partanen & Goel, 2017; Block et al., 2018; Ko & McKelvie, 2018; Parhankangas & Ehrlich, 2014; Tsay, 2021). However, these studies have rarely addressed the background and context in which such signals are selected and constructed.

This study focuses on the formation process of signals, an aspect that has not been adequately addressed by traditional Signaling Theory. It conceptualizes signal formation as a dynamic process constructed through the interaction of the signaler's experiences, values, and socio-cultural context, with a particular emphasis on intrapreneurs. Specifically, the study considers that multiple factors—such as creativity (Shane & Nicolaou, 2015), self-efficacy (Bandura, 1986), developmental stages (Erikson, 1950/1980), and symbolic influences (McAdams, 2001; Gabriel, 2000)—act in a complex manner in shaping signals. Moreover, as intrapreneurs propose new ideas within institutional constraints and seek to gain trust, alignment with the environment and the structure of narratives also play crucial roles (Yamada, 2004). This study aims to extend Signaling Theory by incorporating a dynamic perspective of signal formation.

Signal formation is linked not only to a static self-recognition expressed as "I AM," but also to a willful orientation of "I WILL," reflecting a dynamic and multi-layered self-structure. Valsiner (2014) argues that the self includes intentional orientations such as "I NEED," "I WANT," and "I WILL," which evolve according to situational contexts. Additionally, Sarasvathy (2001) demonstrated that entrepreneurs make decisions based on their means—"who I am, what I know, whom I know"—which in themselves can function as signals.

The formation of signals is significantly influenced by the signaler's cultural background and corresponding self-construal. Markus and Kitayama (1991) highlighted the contrast between independent self-construals common in Western cultures and interdependent self-construals prevalent in East Asian cultures, and argued that these differences are reflected in signaling styles. Individuals with independent self-construals tend to choose signals characterized by confidence and assertiveness, while those with interdependent self-construals tend to prefer modest signals emphasizing harmony and consideration (Heine, 2001). Furthermore, Cross et al. (2011) pointed out that cultural differences also manifest in non-verbal signals such as vocal tone, rhythm, body movements, and eye contact.

3. Study 1: Vocal Characteristics of the Intrapreneur

3.1 Overview of Study 1

The purpose of STUDY 1 is to clarify the vocal characteristics of an intrapreneur by examining differences between his speeches during pitches and in daily conversations. Speech data from a seminar presentation and interview responses by the same intrapreneur were collected. Using Python, vocal indicators such as speech rate (BPM) and fundamental frequency (F0), which reflects vocal pitch, were extracted.

The subject of this study, Hiroya Fujimura, is an intrapreneur with a cross-cultural and cross-industry background. After engaging in musical activities in Tokyo and London, he joined Konami Digital Entertainment Co., Ltd., a leading Japanese gaming company, where he worked for ten years in the localization of the Pro Evolution Soccer series (known in Japan as Winning Eleven). Localization involves more than simple language translation; it is a process that includes adapting expressions to cultural contexts and addressing technical requirements. It also demands negotiation and project management with stakeholders across different linguistic environments, requiring communication skills that transcend language and cultural boundaries. He later moved to DeNA Co., Ltd., where he established a multilingual support division for smartphone games within the game business unit. Currently, he serves as the product owner of "WOVN.games," a dedicated game localization platform, at Wovn Technologies, Inc., where he leads business development. Given this background, he was selected as an intentionally atypical case to explore signal formation. After a music career, he entered business at 40, making him a rare "black swan" whose unconventional path offers insight beyond typical intrapreneurial trajectories.

3.2 Data Collection and Analysis Method

The intrapreneur's speeches were recorded in two contexts: an online seminar and interviews conducted by the author. The seminar audio was obtained from a video provided by the intrapreneur, while the daily conversation audio was extracted from a total of 4 hours and 1 minute of interviews conducted both online and face-to-face. All recordings were made in quiet environments using the Voice Memos app on iPhone. The interviews followed an improvised response format.

All audio data were converted into numerical values for precise comparative analysis. The recordings were converted into WAV format, segmented by sentence, and analyzed using the Python library, librosa to extract BPM (speech rate) and F0 (fundamental frequency). For each context, the median, maximum, and minimum values of BPM and F0 were compared. Additionally, to assess variation between pitch and interview in the intrapreneur's speech, standard deviations were calculated, and statistical significance was tested using Levene's test at a 5% significance level.

3.3 Results of Study 1

Both speech rate (BPM) and fundamental frequency (F0) showed only slight differences between the intrapreneur's pitch and interview contexts. In terms of BPM, the intrapreneur's median value was 115.38 during the pitch and 107.04 during the interview. The BPM ranged from 71.78 to 137.81 during the pitch and from 78.30 to 136.00 during the interview. Regarding F0, the median was 247.76 Hz during the pitch and 212.81 Hz during the interview. The F0 ranged from 208.58 to 283.24 Hz during the pitch and from 194.55 to 237.46 Hz during the interview.

Notably, the intrapreneur exhibited minimal variation between pitch and interview contexts. The standard deviation of BPM was 21.82 during the pitch and 19.51 during the interview, while the standard deviation of F0 was 24.18 during the pitch and 15.13 during the interview. Levene's test showed no statistically significant differences in variability, with $p = 0.70$ for BPM and $p = 0.26$ for F0, both exceeding the 0.05 significance threshold (Table 1).

Table 1: Comparison between the pitch and the interview

	Speaking Scene	Intraprenuer (n = 1)		
		Mdn	*Max*	*Min*
BPM	Pitch	115.38	137.81	71.78
	Interview	107.04	136.00	78.30
F0(Hz)	Pitch	247.76	283.24	208.58
	Interview	212.81	237.46	194.55

3.4 Discussion of Study 1

The observed consistency in the intrapreneur's vocal characteristics across distinct contexts points to a personal, rather than situational, basis for his signaling behavior. First, the vocal characteristics of the intrapreneur showed little variation between pitch presentations and interviews, indicating a consistently stable speaking style. If voice and speech style are regarded as signals, this suggests that there are individual differences in how people send such signals. Furthermore, the minimal variation in his speeches across two distinct contexts—strategically prepared pitch and spontaneously driven interview—suggests that this style is not a situational tactic but rather a stable characteristic cultivated through personal experiences and social background (Cross et al., 2011; Markus & Kitayama, 1991). This consistency may reflect his role as a coherent and authentic signaler.

4. Study 2: Signal Formation Process

4.1 Overview of Study 2

STUDY 2 aims to clarify the elements and processes through which an intrapreneur forms signals. Key elements include challenges, environmental factors, and social influences. The process is traced through the intrapreneur's life experiences, from childhood to the present, examining how consciousness, behavior, and values were shaped and how signals were constructed over time. As a further deep dive, this study also focuses on the signals with which the intrapreneur resonated and how he interpreted them, particularly those influenced by a prominent figure.

The subjects of this study include Hiroya Fujimura, the intrapreneur featured in STUDY 1, as well as the prominent individual he identified as a major influence. In addition to Fujimura's life events, the contents of a book authored by this individual (Namba, 2013) were also analyzed based on his statements. Tomoko Namba is a renowned Japanese entrepreneur and business leader, who earned her MBA from Harvard Business School, became the first Japanese female partner at McKinsey & Company, and later founded the IT company, DeNA Co., Ltd. in 1999, rapidly growing the business in mobile gaming and e-commerce sectors.

4.2 Data Collection and Analysis Method

Data collection was conducted through semi-structured interviews. This method was chosen because signal formation is based on individual experiences and interpretations, requiring flexible and interactive dialogue. Drawing on Erikson's (1950) psychosocial development theory and the narrative approach (Butina, 2015), semi-structured interviews were deemed suitable for capturing the gradual and cumulative nature of self-formation. Both the interviewer and the interviewee were fluent in English and Japanese; however, the interviews were conducted in Japanese and recorded using audio equipment.

In addition, based on the intrapreneur's statements, data were collected regarding the influence of Tomoko Namba's book. The questionnaire items were developed based on the chapter structure of Namba (2013), focusing on key events in each chapter. Specifically, 67 questions were created, covering Chapter 1 "Startup" (7 items), Chapter 2 "Background" (15 items), Chapter 3 "Fundraising" (10 items), Chapter 4 "Mobile Shift" (9 items), Chapter 5 "Social Gaming" (4 items), Chapter 6 "Resignation" (4 items), Chapter 7 "People and Organization" (15 items), Chapter 8 "Looking Ahead" (2 items), and the final chapter "Afterword" (1 item).

Responses were collected via Google Forms using multiple-choice options: "Influenced (both then and now)", "Influenced (only then)", "Influenced (only now)", and "Not influenced".

The analysis was conducted by aggregating and identifying trends from labeled data obtained from both the interviews and the questionnaire, in order to clarify the process of signal formation. For the interviews, MAXQDA was used to label each utterance according to signal elements such as "affiliation," "decision-making," "action," "experience," "environment," "values," "personality," "needs," "aspirations," and "others." These labels were exported to Excel, and the frequency of each element was tallied by life stage to examine how these elements were formed over time, with the aim of systematizing the structure of signal formation. Regarding the questionnaire, the response trends for each chapter were also labeled and aggregated in Excel. The analysis identified which chapters and events had the strongest influence, and these results were compared with the interview narratives to clarify the relationship between the intrapreneur's sense of resonance and perceived influence.

4.3 Results of Study 2

As a result of labeling the interview data, the number of labels assigned to each time period, as well as the proportions of positive (Happy) and negative (Unhappy) emotions, were identified. The number of labels was highest in #4 London (97 labels) and #10 Intrapreneur B (93 labels). #8 DeNA and #9 Intrapreneur A, both related to the same company, totaled 74 labels, ranking third (Table 2). For emotional tendencies, the highest Happy ratios were observed in #4 London (57.1%), #9 Intrapreneur A (50.0%), and #3 Faith (33.3%). The highest Unhappy ratios were found in #6 Marriage (100.0%), #2 Tokyo (83.3%), and #10 Intrapreneur B (80.6%). Category #0 includes labels that do not correspond to any of the specific time periods. The total number of labels is 511.

Table 2: Summary of labels over different time periods

Time Period	#0	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
	All	Home Town	Tokyo	Faith	London	Master Degree	Marriage	Konami	DeNA	Intrapreneur A	Intrapreneur B
Positive	0%	25.0%	16.7%	33.3%	57.1%	25.0%	0%	42.9%	22.2%	50.0%	19.4%
Negative	0%	75.0%	83.3%	66.7%	42.9%	75.0%	100%	57.1%	77.8%	50.0%	80.6%
Total	7	46	33	44	97	64	11	42	19	55	93

The survey results revealed both overall trends and chapter-specific differences in the perceived influence of Namba (2013). Among the 67 items, the most frequent response was "influenced (both then and now)," accounting for 74.63% (50 responses). This was followed by "not influenced" at 19.40% (13 responses), "influenced (only then)" at 4.48% (3 responses), and "influenced (only now)" at 1.49% (1 response). The "only then" responses mainly related to practical decisions involving new business development and personnel management, while the "only now" response concerned reflections on parent–child relationships. By chapter, the influence was reported in 6 out of 7 items (85.7%) in "Startup," 9 out of 10 items (90.0%) in "Fundraising," and 13 out of 15 items (86.7%) in "People and Organization." In contrast, no influence was reported in the single item under "Afterword," and only 1 out of 2 items showed influence in "Looking Ahead." Due to the small number of questions in the latter chapters, these ratios should be interpreted with caution.

4.4 Discussion of Study 2

STUDY 2 confirmed that signal formation is not dependent on age and can be acquired at any stage of life. In particular, during the #4 London period, the Christian church community in London played a significant role. The influence extended beyond shared values, deeply affecting his self-perception and narrative through advice and support from others. Among these, the most profound signal that supported him was the words of the Bible. He stated, "It's God, I think. It's the Bible. [...] 'Take heart! I have overcome the world. And surely I am with you always, to the very end of the age.' (John 16:33; Matthew 28:20)." Such religious beliefs and the words derived from them have remained an internal source of strength, enabling him to move forward without faltering even

in negative situations, and continue to influence his signal formation to this day. Furthermore, the notion that signals can be acquired throughout life is also evident in the #6 Marriage period, where he transitioned from a beloved rock musician to his first role as an employee at a company (Konami), marking a significant shift in identity. This turning point was critically facilitated by his wife's support, who acted as a Third-party Signaler, fostering the formation of new signals. Today, in addition to his wife, his children also serve as a daily source of support, contributing to the ongoing reinforcement of these signals.

Additionally, the Segment analysis revealed a strong relationship between emotional intensity and both the volume and detail of his narratives. Experiences that were emotionally significant, whether positive or negative, were repeatedly discussed and functioned not merely as memories but as internalized stories. Moreover, his empathy with Namba (2013) and Namba herself further confirms that signals are not temporary reactions but are sustained by experiences internalized over time. Thus, signal formation is a dynamic process constructed at the intersection of emotion, time, practice, and relational contexts, deepened through the interaction of internal resilience and external support from others.

The findings suggest that signal formation is not a linear accumulation of experiences, but a dynamic process shaped by meaningful experiences and supported by social relationships. Elements such as religious beliefs, family support, and external narratives influenced shifts in self-perception and behavior. This supports Valsiner's (2014) idea of affective scaffolding and Erikson's (1950) life-span development theory. The case shows that signals can be acquired at any age when practice is driven by passion and challenge.

5. General Discussion

5.1 Signal Formation Cycle and Process

This study identified two key insights regarding signal formation: the cycle and the process of signal development. Figure 1 illustrates the cycle of signal formation, which represents the recurring nature of signal development in different periods of life. These cycles accumulate over time, successively building upon one another, and through their continuity, they evolve into a sustained process of signal formation. The concepts of I AM, I WILL, I NEED, and I WANT are based on Valsiner (2014). In contrast, I HAVE is an original concept developed by the author. Additionally, elements such as Receiver and Environment are constructed with reference to Bafera & Kleinert (2022).

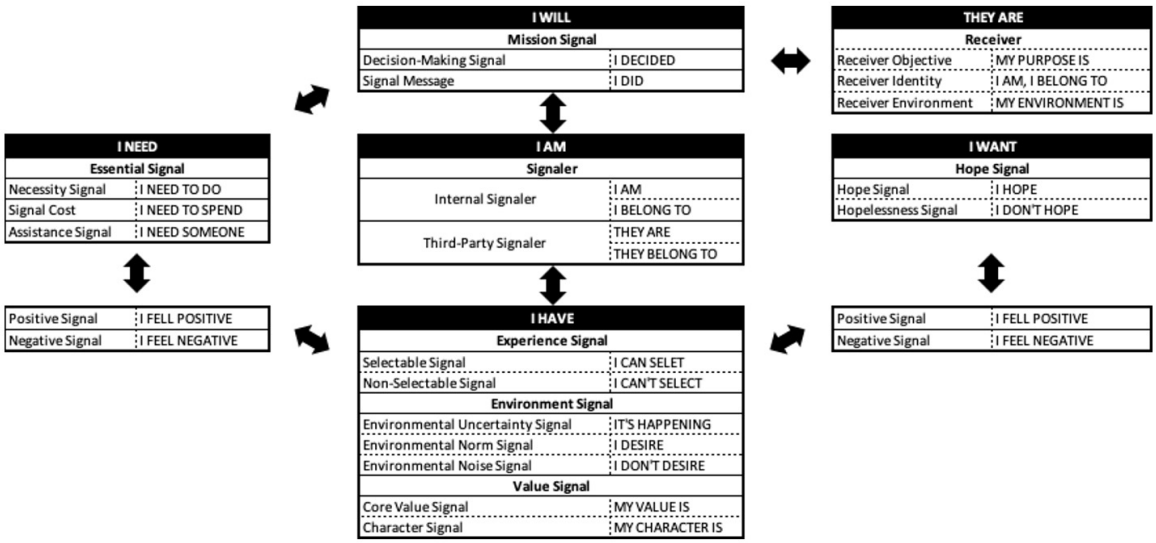


Figure 1: Signal Formation Cycle and Process

Despite facing constant change and adversity, Fujimura continues to emit signals with unwavering passion and determination. His actions demonstrate that signal formation is not a transient phenomenon, but rather emerges as a recurring cycle shaped by accumulated experiences in each stage of life, ultimately developing into a continuous process. In this respect, his journey is reminiscent of the spirit embodied in "Don't Stop Me Now" by his fellow alumnus Freddie Mercury, as he persistently advances and evolves his signals without pause.

5.2 Theoretical and Practical Implications

This study contributes to Signaling Theory by shifting the focus from the commonly emphasized "types" and "effects" of signals (Spence, 1973) to the dynamic process of signal formation. While existing reviews (Bafera & Kleinert, 2022) have classified 18 types of signals through major studies and focused primarily on their effects, they have not addressed how signals are formed. This study demonstrates that signals are continuously constructed through the experiences and relationships of the signaler, aligning with Sarasvathy's (2001) effectuation theory and the perspective of cultural psychology's "I AM" research, which views the self as formed in relation to others (Valsiner, 2014).

Effective signaling requires a process of reflecting on one's experiences and internalizing one's values. For intrapreneur development, this suggests that beyond formal education, it is essential to foster environments that support individual growth. Furthermore, in investment decision-making, it is valuable to consider not only financial indicators but also the life experiences and personal qualities of entrepreneurs and intrapreneurs.

5.3 Limitations and Future Research

This study is an exploratory case study based on a single intrapreneur, and caution is required when generalizing the findings. Generalization requires comparisons involving different cultural and religious backgrounds, as well as multiple intrapreneurs and entrepreneurs. Future research should clarify the universality and diversity of signal formation through more varied cases. Additionally, the labeling of qualitative data requires more robust systems to ensure higher reproducibility.

6. Conclusion

This study revealed that signals among business professionals, particularly intrapreneurs, are shaped through life experiences and interpersonal relationships. The intrapreneur analyzed in this study consistently demonstrated a natural and authentic speaking style across various situations, indicating that his signals were not temporary or situational, but grounded in stable personal values and experiences. Furthermore, the qualitative analysis showed that signal formation is not a single event, but a process composed of multiple emotionally significant experiences, each forming a cycle that connects and builds upon the others over time. These findings extend Signaling Theory by shifting attention from the outcomes of signals to the way they are formed.

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Ethics Declaration

Ethical clearance was not required for this research.

AI Declaration

An AI tool (ChatGPT by OpenAI) was used during the development of this paper for language editing only. All AI-generated content was reviewed and revised by the author to ensure accuracy, originality, and alignment with the research goals.

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Prison Entrepreneurship Education: A Systematic Literature Review

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Abstract: This article presents a systematic literature review (SLR) on prison entrepreneurship education, aiming to explore existing knowledge about prison education systems that promote entrepreneurial skills recognized by prisoners. Criminal recidivism is a complex, worldwide social problem for which there seems to be no optimal solution, only preventive measures. Its prevention promotes a social benefit for society as a whole. Lack of employment continues to be a factor in the social reintegration of prisoners, increasing the likelihood of recidivism. The few studies that portray the effect of programs involving entrepreneurship and education in prisons indicate that they are successful in being accepted by the prison population based on their proposed educational opportunities. However, this analysis is not conclusive when it comes to the recognition of opportunities by prisoners, and there is a need for more studies to be carried out to gauge an informed response and support the development of new policies to help meet this social need for successful social reintegration. However, in many countries, the educational offer of entrepreneurship programs does not cover all prisoners. This SLR includes results on entrepreneurship education in prisons regarding the recognition of entrepreneurial skills. It also partially explains the effects of entrepreneurship education in the prison system. The results of this SLR highlight the need for more comprehensive public policies and more effective entrepreneurial educational practices. It is necessary to ensure that all citizens deprived of their liberty have access to entrepreneurship education and that these initiatives align with the employment opportunities available in the labor market. Considering the existing limitations in research in this area, namely the small number of academic studies involving prisoners, combined with the difficulty for researchers to "enter" prison systems, we believe that this study is significant, given that the associated issues of criminal recidivism versus social reintegration affect society as a whole.

Keywords: Education; Entrepreneurship; Entrepreneurship program; Lifelong learning; Prison; Prisoners.

1. Introduction

This SLR aims to outline the international state of the art of prison entrepreneurship education and its contributions to promoting and recognising entrepreneurial skills. It also aims to learn about existing limitations and explore the path that future research should take to answer the SLR's central question, considering the evidence, gaps, and limitations identified.

Education is a key factor for entrepreneurs and is vital in affecting their bottom line (Van der Sluis, Van Praag, and Vijverberg, 2008). Prisoners are deprived of their freedom, but they retain the right to education, and they must have the skills and knowledge necessary to face the difficulties of (re)entering the job market after their release.

In a broad definition, entrepreneurship education is compared to the general skills considered useful for preparing for life that all students should learn and, in a narrow definition, emphasizes that entrepreneurship education is a specific training course for setting up one's own business, wich, with different definitions, teachers find it difficult to convert curriculum content into practice (Fejes et al., 2019). From a different perspective, entrepreneurship education promotes socio-emotional competences while developing important skills and values (Salzano et al., 2006; UNESCO, 2024).

Fayolle and Gailly (2005) understand that teaching programs for entrepreneurship are very diverse and depend a lot on the target audience, the teachers, the objective, and the methodology used. In general, entrepreneurship education programs provoke a change in students' mentality, a change in attitudes, and the development of some entrepreneurial orientation that can be assessed through intentions (Ceresia, 2018; Fayolle and Gailly, 2005).

The primary function of education in the prison system is to increase the qualifications of citizens deprived of their liberty to reduce criminal recidivism (Flynn and Higdon, 2022; Reese, 2019).

The ability to identify entrepreneurial opportunities, the attitude towards risk, and the lack of job opportunities, all influence the intention to set up one's own business (Hil et al., 2024; Raposo and Paço, 2011).

Entrepreneurial skills include acting on opportunities and ideas and turning them into value for society (European Commission [EC], 2019). These skills are based on creativity, critical thinking, problem-solving, initiative, perseverance, and teamwork (EC, 2019).

This SLR aims to answer the question: What do we know about prison education systems that promote entrepreneurial skills recognized by prisoners?

2. Methodology

2.1 Research Protocol

This aims to identify articles that address the topic of prison entrepreneurship education and discuss their contribution to the promotion and recognition of entrepreneurial skills in adult citizens deprived of liberty. For a robust analysis of the existing articles, the following keywords were validated by a researcher from the field of management and two researchers from the field of education: *Correctional education; Education; Entrepreneurial activity; Entrepreneurial program OR Entrepreneurship program; Entrepreneurship; Detainees OR Convicts OR Inmates OR Incarcerated OR Offenders; Lifelong learning; Prison; Prison education; Reentry programs; Rehabilitation programs; Rehabilitation through education; Self employment OR Self-employment; Social reintegration.*

When developing the SLR, two new keywords were added because they proved relevant when searching the databases: *Vocational education* and *vocational training*.

The research used Web of Science (WoS), Scopus, and EBSCOhost databases. It examined scientific articles published in Spanish, French, English, and Portuguese between January 2000 and December 2024.

The search was performed in January 2025 and was limited to peer-reviewed scientific articles and academic journals classified as Q1 or Q2 in the Journal Citations Reports (JCR).

One limitation of the research protocol is that the SLR only includes articles published in Q1 and Q2 journals.

The SLR protocol is described in Figure 1.

Research question	What do we know about prison education systems that promote entrepreneurial skills recognized by inmates?
SLR Objective	To analyze and systematize the existing literature in the field of academic research that investigates entrepreneurship and education in the prison system.
Databases	Web of Science; Scopus; EBSCOhost
Keywords	Correctional education; Education; Entrepreneurial activity; Entrepreneurial program OR Entrepreneurship program; Entrepreneurship; Detainees OR Convicts OR Inmates OR Incarcerated OR Offenders; Lifelong learning; Prison; Prison education; Reentry programs; Rehabilitation programs; Rehabilitation through education; Self employment OR Self-employment; Social reintegration; Vocational education; Vocational training.
Articles	Spanish / French / English / Portuguese
	Peer-review
	Academic journals
Identification	The articles were identified by searching the databases for results with various combinations of the key words Web of Science, Scopus and EBSCOhost.
	The period from January 2000 to December 2024.
Screening	After eliminating duplicates, the initial screening included articles with the following keywords in the title or abstract: Entrepreneurship, Education or Lifelong learning, and Prison or Convicts/Inmates/Incarcerated/Offenders. In a second phase, the JCR classification was carried out and only articles published in journals with JCR (2023) Q1 or Q2 were selected.
Eligibility	Full-text reading and analysis of the articles selected in the screening to assess whether they meet the research criteria and contribute to the SLR issue.
Included	Selection and confirmation of the articles to be analyzed and included in the SLR. Exclusion of articles that do not contribute to answering the research question.

Figure 1: SLR Protocol

Nineteen combinations of keywords were used to identify 2297 articles in the database search. A total of 1154 duplicates and eleven articles with unknown authors were eliminated.

The screening phase included 1132 articles and was carried out in two stages. The first considered the inclusion of keywords in the title and abstract, reducing the sample to 150 articles. In the second, the 150 articles were classified according to the JCR ranking of the journal in which they were published, based on the WoS Journal Citation Reports for the year 2023, and 120 articles were excluded. The 30 remaining articles for the eligibility phase were fully read and analyzed, and only 23 were included. Exploring some of the citations of articles that seemed relevant, three more articles were included, bringing the number to 26. Of the articles in the SLR, 25 were written in English and 1 in Spanish.

Reasons for article exclusion:

1. Focus on the prison context during deprivation of liberty, but do not address the development of entrepreneurial skills/education in this context;
2. Temporal and contextual relevance of educational/entrepreneurial programs, focusing only on the effects of ex-prisoners' stigma on finding a job.

To describe the process (see Figure 2), we used PRISMA 2020, a flowchart (Preferred reporting items for systematic reviews and meta-analyses), based on Page et al. (2021).

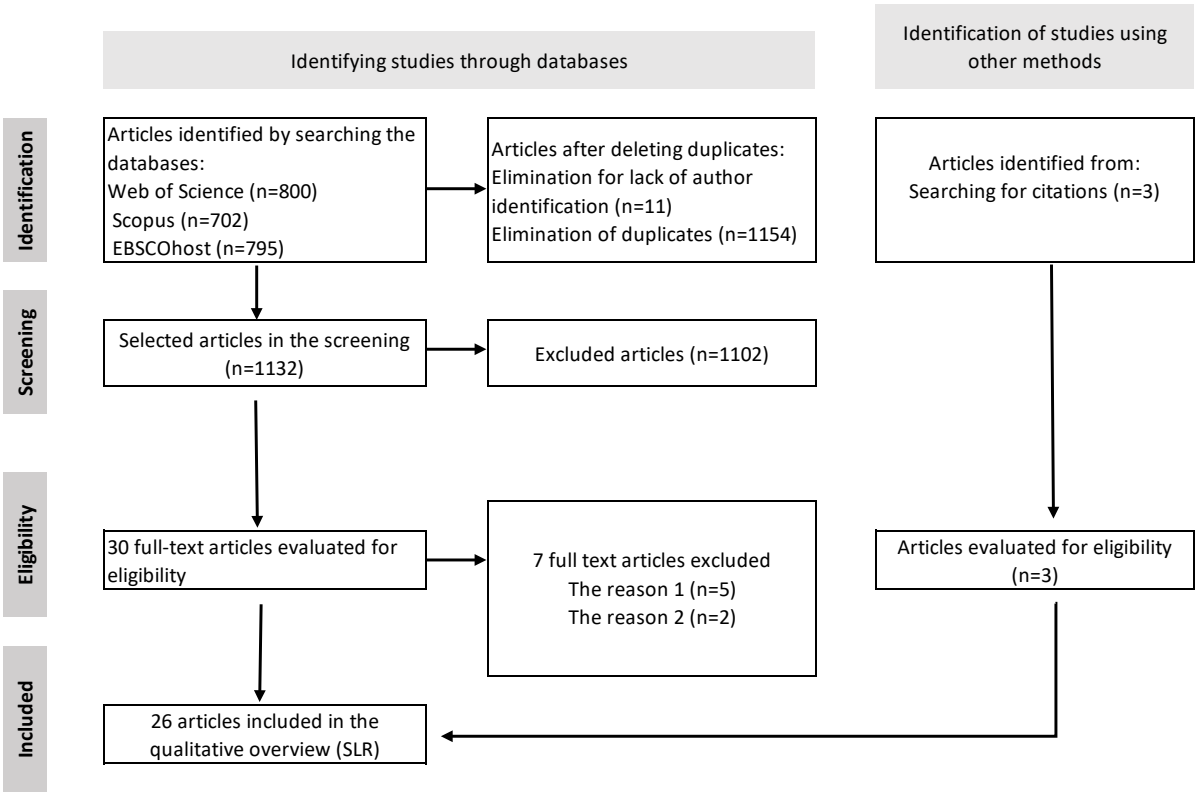


Figure 2: Flow chart - PRISMA 2020

2.2 Descriptive Analysis

Table 1 identifies the included articles.

Table 1: Identification of the articles included in the SLR

Title	Authors/year	Academic journal	Ranking (JCR)	Method	Country / Continent
A meta-analysis of corrections-based education, vocation, and work programs for adult offenders	Wilson et al. (2000)	Journal of Research in Crime and Delinquency	Q1	Quantitative	n.a. (Meta-analysis)
Prison's Dilemma: Do Education and Jobs Programmes Affect Recidivism?	Sedgley et al. (2010)	Economica	Q1	Quantitative	United States of America
The role of adult education in the integration of inmates into society after a jail term: Practical experiences from Swaziland	Biswalo (2011)	International Journal of Lifelong Education	Q2	Qualitative	Swaziland
Corrections education and employment assistance 'down under': Current and emerging practices and paradigms	Graffam et al. (2014)	London Review of Education	Q2	Qualitative	Australia
Overcoming the Walls That Constrain Us: The Role of Entrepreneurship Education Programs in Prison	Patzelt et al. (2014)	Academy os Management Learning & Education	Q1	Qualitative	Europe
The Aspirations and Realities of Prison Education for Under-25s in the London Area	Rogers et al. (2014)	London Review of Education	Q2	Qualitative	United Kingdon
Effects of prison work programmes on the employability of ex-prisoners	Alós et al. (2015)	European Journal of Criminology	Q1	Quantitative	Spain
The role of art education in adult prisons: The Western Australian experience	Giles et al. (2016)	International Review of Education	Q1	Quantitative	Australia
Adult higher education in a Portuguese prison	Moreira et al. (2017)	European Journal for Research on the Education and Learning of Adults	Q2	Qualitative	Portugal
La educación superior a distancia y el e-Learning en las prisiones en Portugal / Higher education distance learning and e-Learning in prisons in portugal	Moreira et al. (2017)	Comunicar	Q1	Qualitativee	Portugal
Education in Prison and the Self-Stigma: Empowerment Continuum	Evans et al. (2018)	Crime & Delinquency	Q2	Qualitative	United States of America
Makeright—Bags of Connection: Teaching Design Thinking and Making in Prison to Help Build Empathic and Resilient Communities	Gamman and Thorpe (2018)	She Ji-The Journal of Design Economics and Innovation	Q1	Qualitative	United Kingdon and India
Prison Break. Education of Young Adults in Closed Prisons--Building a Bridge from Prison to Civil Society?	Mertanen et al. (2018)	Education Inquiry	Q2	Qualitative	Finland
Application of the Literacy Training Service component of the National Service Training Program in New Bilibid Prison (Philippines)	Lopez (2019)	International Review of Education	Q1	Mixed method	Philippines
The Prison Education Project	Reese (2019)	International Review of Education	Q1	Qualitative	United States of America
Why do not more prisoners participate in adult education? An analysis of barriers to education in Norwegian prisons	Manger et al. (2019)	International Review of Education	Q1	Quantitative	Norway
Prison education in Norway - The importance for work and life after release	Tonseth and Bergsland (2019)	Cogent Education	Q2	Qualitative	Norway
The transformative effect of correctional education: A global perspective	Vandala (2019)	Cogent Social Sciences	Q2	Mixed method	South Africa
From Prison to Entrepreneurship: Can Entrepreneurship be a Reentry Strategy for Justice-Impacted Individuals?	Hwang (2022)	Annals of the American Academy of Political and Social Science	Q1	Qualitative	United States of America
Replanting life: ecological and human restoration	Abreu et al. (2022)	Restoration Ecology	Q2	Qualitative	Brazil
The influence of correctional education, skill proficiency, and lifelong learning on social outcomes of incarcerated individuals: Results from PIAAC	Galeshi and Bolin (2022)	Social Science Journal	Q2	Quiantitative	United States of America
Examining prison entrepreneurship programs, self-efficacy and entrepreneurial resilience as drivers for prisoners' entrepreneurial intentions	Ciptono et al. (2023)	International Journal of Entrepreneurial Behavior & Research	Q1	Quantitative	Indonesia
Incarcerated individuals and education programmes in Nigeria: A task for social workers	Uche et al. (2023)	Plos One	Q1	Qualitative	Nigeria
Female's self-concept as online learners in the context of lifelong learning in prisons	Monteiro et al. (2023)	International Journal of Lifelong Education	Q2	Mixed method	Portugal
Are Schools in Prison Worth It? The Effects and Economic Returns of Prison Education	Stickle and Schuster (2023)	American Journal of Criminal Justice	Q2	Qualitative	United States of America
Competency-based training within the prison system: enhancing the likelihood of entrepreneurial activity upon release	Brophy et al. (2024)	Journal of Education and Work	Q2	Qualitative	Ireland

3. Results

The results are presented according to the type of education the articles fall under. The definition of each educational term was drawn up based on the International Standard Classification of Education, which harmonizes educational information and covers almost all countries, and is supported by the UNESCO Institute for Statistics (Schneider, 2013).

3.1 Lifelong Learning

Lifelong learning encompasses all ages in all contexts, includes various modalities, such as formal, non-formal, and informal, and covers multiple learning needs and requirements (UNESCO, 2024).

Biswalo (2011) identifies a gap between the practical skills developed by prisoners and the need for additional skills, recommends improving education programs for adults serving time in prison, and highlights the importance of acquiring entrepreneurial skills for successful social reintegration.

Mertanen and Brunila (2018) comment that through education, work, and training, inmates see themselves as free citizens without the inconveniences of everyday reality, inequalities, and obstacles. The authors consider that education, which is made possible for these citizens, has ambivalent objectives since it makes them more responsible and increases their self-esteem, thinking, and emotional skills. Still, they point out that the risk of failure is always present.

Lopez (2019) designed a framework for the Alternative Learning System program, noting that inmates attending the program are provided with lifelong learning as a survival tool, highlighting the importance of the government investing in education in the prison system.

Reese (2019) carried out a study in which he compared the United States of America(USA) prison system with progressive correctional systems around the world, namely the development of the Prison Education Project, which began in 2011. Reese (2019) notes that the lack of education is a common factor in the prison system, leading to serious social consequences.

Manger et al. (2019) studied the development of the Perceived Barriers to Prison Education Scale and why prisoners do not participate in education during their time in prison. They consider barriers to education to be important in decision-making and choice of participation and identify three barriers to education: institutional, situational, and dispositional.

Galeshi and Bolin (2022) conducted a study based on data from the 2014 United States Prison Survey of the Programme for the International Assessment of Adult Competencies. The authors show that education promotes access to information, which, in turn, helps citizens deprived of their liberty to make well-informed decisions and become more resilient in a constantly changing society.

Monteiro et al. (2023) conducted a study in a women's prison in Portugal. They identified some negative aspects related by inmates, such as difficulty understanding some content, being unable to explore the internet freely, and preferring the teacher's physical presence (Monteiro et al., 2023). The positive aspects mentioned are diversification and the opportunity to attend courses while deprived of liberty. They concluded that the participants recognize the importance of lifelong learning in a non-formal context.

The studies converge in their emphasis on the importance of Lifelong Learning as an essential tool for prisoners.

3.2 Education and Correctional Education

Education involves communication to promote learning and transmit knowledge, information, understanding, attitudes, values, skills, competencies, and behaviors accumulated over generations (UNESCO, 2024).

Correctional education involves education or training programs provided in correctional institutions (UNESCO, 2024).

The study of Sedgley et al. (2010) concludes that prison system programs, including jobs inside and outside prison and education programs, contribute significantly to reducing the recidivism rate. The authors mention that well-structured programs that offer vocational skills and education help inmates see their future with more optimism, supporting, even indirectly, potential entrepreneurial activities.

Moreira, Monteiro and Machado (2017a) carried out a study in a prison, and the results point to the existence of motivation to complete the course since inmates perceive a more inclusive future after release. Following the previous study, Moreira, Monteiro and Machado (2017b) show that inmate students consider distance learning favorable since they have no other option for higher education, and are allowed to complete their studies in any prison in the country.

Evans, Pelletier, and Szkola (2018) interviewed eighteen ex-prisoners who had served a custodial sentence and attended higher education during that period. They recognized the empowerment that education had offered them, and other respondents assumed that participating in education programs helped them develop a work ethic, study routines, and critical thinking. The authors conclude that the study does not prove that education is the definitive solution to successful social reintegration, but reflects the value ex-prisoners place on the education they received during prison.

Tonseth and Bergsland (2019) conducted a study to understand how formal education in prison has affected inmates' lives after release. They concluded that education in prison contributes to social benefits, self-determination, and accountability, allowing ex-prisoners to improve their mastery and self-esteem. Most interviewees highlighted the importance of education in prison (Tonseth and Bergsland, 2019).

Vandala (2019) studied the transformational effect of correctional education and concluded that it promotes inmates' rehabilitation, develops their self-esteem and self-confidence, strengthens professional skills, improves cognitive abilities, promotes growth, and improves literacy levels.

Uche et al. (2023) investigate how citizens deprived of liberty perceive education programs. The authors conclude that although correctional education is seen as an asset for social reintegration, its effectiveness is limited by the quality of teaching and the negative perception that citizens deprived of liberty have about employment opportunities after release.

Stickle and Schuster (2023) conducted a meta-analysis and confirmed that education in prison is effective and promotes a reduction in recidivism, increasing the likelihood of employment and wages after release.

Uche et al. (2023) consider that the action of correctional education is limited due to the lack of quality of education, diverging from other studies which indicate that correctional education contributes to reducing the rate of recidivism and promotes social and professional skills.

3.3 Entrepreneurship Education

Entrepreneurship education refers to education elected to inform, train, and educate any citizen who wishes to contribute to social and economic development through initiatives that promote knowledge about entrepreneurship (UNESCO, 2024). Entrepreneurial education is viewed more broadly and aims to boost citizens' self-esteem and confidence by harnessing talent and creativity while developing important skills and values (Salzano et al., 2006; UNESCO, 2024).

Graffam, Shinkfield and Lavelle (2014) comment on the challenges of the prison system and state that transformative change is at the heart of the social reintegration paradigm. They note that short-term rehabilitation programs or intensive assistance are sufficient to produce lasting results and consider education and employment crucial for successful social reintegration.

While attending an entrepreneurship education program, 5 of the 12 inmates interviewed by Patzelt, Williams and Shepherd (2014) dropped out. The authors note that, during the interview, the prisoners who dropped out were those who blamed others for serving their sentence. They confirm that inmates who attended the entrepreneurship education program showed a strong appetite for starting their own business. (Patzelt, Williams and Shepherd (2014) consider recognizing entrepreneurial opportunities based on the inmates' understanding of their condition, their motivation for their future after release, and their persistence in completing the program.

Giles, Paris and Whale (2016) conducted a study on correctional education in general and arts education in particular and reported that inmates have acquired the necessary skills for short or vocational courses.

Gamman and Thorpe (2018) implemented a socially responsible design course called “Makeright” to engage and provide transformational learning for inmates and enable them to develop resilience and entrepreneurial skills. During the course, the inmates identified opportunities, and a certification process was created to recognize their learning and contribution to the program (Gamman and Thorpe, 2018).

Given the difficulties citizens who have served a custodial sentence have in finding a job, Hwang (2022) explores an alternative way to overcome this difficulty: entrepreneurship. He states that providing citizens deprived of their liberty with entrepreneurial skills is necessary. Considering entrepreneurship programs in the prison system do not cover all prisoners, Hwang (2022) stresses the importance of balancing support for entrepreneurship with integration into the labor market for citizens who have served a prison sentence.

After testing some hypotheses, Ciptono, Anggadwita and Indarti (2023) demonstrate the importance of entrepreneurship education and identify the factors that support inmates' entrepreneurial intentions, namely entrepreneurship programs, self-efficacy, and entrepreneurial resilience.

Brophy, Pérez-Luño and Cooney (2024) explore a training approach based on competencies, knowledge, skills, and behaviors necessary for citizens deprived of liberty to improve their entrepreneurial prospects. The authors found that the participants evoked a lot of knowledge, skills, and behaviors necessary for entrepreneurship during the interviews. However, these skills seem to be underdeveloped among prisoners, and they are not sure that they will be suitable for the job market when they are released. The opportunity recognition and evaluation, as entrepreneurial skills of prisoners, need to be further explored if prisoners are to become successful entrepreneurs after their release (Brophy, Pérez-Luño and Cooney, 2024).

Studies show that entrepreneurship education is essential for prisoners to be successful both in finding a job and in setting up their own business after release.

3.4 Education and Vocational Training

According to UNESCO (2024), vocational training is work-related learning in vocational and technical schools, training centers or institutes, and even the workplace.

Wilson, Gallagher and MacKenzie (2000) performed a meta-analysis and evaluated the effectiveness of prison education, vocational training and work programs. The main conclusions of the authors were that post-secondary education and vocational training had the most positive effects on reducing the recidivism rate and employment rates after serving a prison sentence.

A study by Rogers et al. (2014) analyzes prison education for young adults deprived of their liberty and reveals that despite the prison system's efforts to provide good training, education has limitations regarding the variety, duration, and level of courses. The authors highlight the importance of education and vocational training for developing entrepreneurial skills.

Alós et al. (2015) used Spanish Social Security data to study a group of citizens who had served prison sentences. The authors conclude that the results show the positive effect of prison work on employability, the little impact that vocational training has on improving job opportunities, given the low professional content that makes them more ambiguous, and the fragility of integration into the labor market. Alós et al. (2015) state that prison work programs and vocational training need to be aligned with the needs of the labor market.

In Brazil, during the implementation of the Replanting Life Program (*Programa Replantando Vida* - PRV), Marques de Abreu et al. (2022) evaluated the environmental benefits of the PRV motivation and the perception of personal changes after finishing work in the program. The authors concluded that vocational training courses have helped achieve the PRV's objectives, and with work practice, training increases prisoners' sense of entrepreneurship.

4. Discussion

The studies included in the SLR converge in the sense that education and entrepreneurship are interconnected and reveals that participation in entrepreneurship education programs not only increases the likelihood of prisoners becoming entrepreneurs, but also equips them with essential skills (critical thinking, problem solving, communication, teamwork) that are crucial for successful social reintegration (Patzelt, Williams and Shepherd, 2014; Giles, Paris and Whale, 2016; Evans, Pelletier and Szkola, 2018; Gamman and Thorpe, 2018; Lopez, 2019; Hwang, 2022; Marques de Abreu et al., 2022).

Studies show that attending entrepreneurship education programs develops entrepreneurial skills and, in some cases, helps overcome personal and psychological situations, making inmates accept their past and look optimistically to the future (Patzelt, Williams and Shepherd, 2014; Ciptono, Anggadwita and Indarti, 2023). These programs support the identification of entrepreneurial skills in prisoners and the ability to identify entrepreneurial opportunities (Gammam and Thorpe, 2018). Prisoners who attend these programs are more

likely to become entrepreneurs, starting their own business (Brophy, Pérez-Luño and Cooney, 2024; Patzelt, Williams and Shepherd, 2014).

The studies analysed show a lack of entrepreneurship education programs that can reach the majority of citizens deprived of their liberty (Biswalo, 2011; Reese, 2019). It is uncertain that the skills and/or opportunities recognized by inmates are adapted to the job market since the reality outside the prison walls has changed during their time in prison (Reese, 2019).

Studies carried out in North America, particularly in the USA, highlight the need to invest in education in prisons (Sedgley et al., 2010), not only as a way of mitigating the stigma of being an ex-prisoner (Evans, Pelletier and Szkola, 2018), but also because social reintegration is more likely to be successful (Reese, 2019), as opportunities to enter the job market increase (Galeshi and Bolin; 2022; Hwang, 2022; Stickle and Schuster, 2023). In South America, in Brazil, most prisoners who attended vocational training at the PRV showed an entrepreneurial attitude (Marques de Abreu et al., 2022).

Studies carried out on the African continent, Swaziland, South Africa and Nigeria, highlight the importance of education programs in the lives of prisoners (Biswalo, 2011; Vandala, 2019) and the importance of their quality (Uche et al., 2023).

Studies in the countries of the Asian continent, India, the Philippines and Indonesia, point to the relevance entrepreneurship education (Ciptono, Anggadwita and Indarti, 2023; Gamman and Thorpe 2018) and the impetus it provides for self-employment (Lopez, 2019). In Australia, studies show the positive effects of short-term educational programs and vocational training (Giles, Paris and Whale, 2016; Graffam, Shinkfield and Lavelle, 2014).

Studies from the European continent, Spain, Ireland, Finland, Norway, Portugal and the United Kingdom, reflect the positive effects that prison work has on inmates (Alós et al., 2015; Mertanen et al., 2018; Rogers et al., 2014) and the importance of education (Monteiro et al., 2023; Moreira, Monteiro and Machado, 2017a, 2017b).

5. Conclusions

The results obtained are not conclusive regarding the premise that prison systems promote entrepreneurial skills and that citizens deprived of their liberty identify and recognize these skills (Biswalo, 2011; Brophy, Pérez-Luño and Cooney, 2024; Ciptono, Anggadwita and Indarti, 2023; Hwang, 2022). However, some studies show that prisoners recognize the benefits of education (Brophy, Pérez-Luño and Cooney, 2024; Evans, Pelletier and Szkola, 2018; Galeshi and Bolinl, 2022; Gamman and Thorpe, 2018; Lopez, 2019; Mertanen and Brunila, 2018; Monteiro et al., 2023; Patzelt, Williams and Shepherd, 2014; Sedgley et al., 2010; Tonseth and Bergsland, 2019). Some inmates' failure to recognize entrepreneurial opportunities after release seems to be linked to a lack of entrepreneurship education or vocational training programs that reflect the needs of the labor market (Alós et al., 2015; Brophy, Pérez-Luño, and Cooney, 2024; Hwang, 2022; Uche et al., 2023).

From a lifelong learning perspective, entrepreneurship education provides relevant skills for reintegration into the labor market (Galeshi and Bolin (2022; Lopez, 2019).

Attending higher education in prison is an important factor for many inmates, as they see their opportunities to enter the job market increase and the possibility of continuing their studies after their release (Monteiro et al., 2023; Moreira, Monteiro and Machado, 2017a, 2017b).

According to some authors, in some countries, either due to lack of interest or other unidentified transversal reasons, educational offer of entrepreneurship programs doesn’t cover all prisoners, as the case in the Australia (Graffam et al., 2014), Norway (Manger et al., 2019; Tonseth & Bergsland, 2019), Philippines (Lopez, 2019), South Africa (Vandala, 2019), UK (Rogers et al., 2014), USA (Sedgley et al., 2010; Evans et al., 2018; Ciptono et al., 2023).

The published studies do not provide a definitive answer to the question of SLR: What do we know about prison education systems that promote entrepreneurial skills recognized by prisoners?. More studies need to be carried out that focus on this aspect, as well as present studies carried out inside prisons and after release. By cross-referencing data gathered within the prison system, through statements by prisoners, with data gathered after release, and with testimonies from former prisoners, a more holistic view of entrepreneurship and education in prison will be possible.

Ethics Declaration

I declare that ethical authorization was not required for this research.

AI Declaration

Use of AI for Grammarly and DeepL Translate during document translation.

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Pragmatic Teaching Case Study: Business Analysis of Entrepreneurship in China's Emerging Industry

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Abstract: This article creatively transforms a case study and interview with an entrepreneur and his startup media enterprise into a cohesive essay, incorporating elements of a teaching plan, case study, and profile interview. The special point is the case, and the storytelling presents a real-life journey of the protagonist Chen Yurong. Additionally, the case examines the interplay between personal passion, industry trends, market competition, and entrepreneurial strategy. With the rise of AI-generated content, smartphone media production, the metaverse, and the influencers in China, Meijing Media has faced both structural challenges and business dilemmas. At the same time, the entrepreneur's mentality is also a critical element in the transition and decision-making process for business strategy. This essay utilizes qualitative research methods, including SWOT analysis, Porter's Five Forces model, the theory of charismatic leadership, and interview techniques. In the article, the entrepreneur's business issues are categorized into market issues, industry issues, human resource issues, and mentality issues. While these methods are commonly found in various articles, research papers, and case studies, applying them to real-life situations alongside organizational behavior theory is still relatively rare. This approach can be considered innovative. This case aims to guide business students in building coherence and sharpening their strategic decision-making capacity in a competitive environment characterized by resource constraints. The final chapter offers insights from the lecturer's perspective, focusing on the structure of the case study. It discusses the practical application of theory, effective tactics for conducting business interviews, and considerations regarding the validity of the interview process. The article presents an innovative approach to thinking and a method for illustrating qualitative research in practical applications, based on real-world business interviews. It aims to provide insights and references for business management curricula and MBA courses. Additionally, it can serve as a comprehensive business case study, benefiting entrepreneurs and reinforcing entrepreneurship.

Keywords: Entrepreneurship, Media Industry, Business Strategy, Business Case Study, Enterprise Transformation

1. Introduction

In the era of rapid technological development and its impact on employment markets, the rise of Generation Y has led to the adoption of new entrepreneurial paradigms driven by individualism, idealism, and a pursuit of self-expression. Amidst such transitions, this teaching case investigates the real-world entrepreneurial journey of Meijing Media, a sole proprietorship founded by Chen Yurong, a former project manager who pivoted toward the creative media industry in Shanghai. His story encompasses the dilemmas he faced as a solo entrepreneur navigating passion, market uncertainty, and digital transformation, which challenge conventional business management models.

Set against the backdrop of China's burgeoning yet intensely competitive media sector, the case explores the intersection of personal aspiration and structural constraints. With the proliferation of AI-generated content, influencer economies, and low-cost digital tools, Meijing Media confronts a volatile business environment that pressures traditional service-based firms. The founder's insistence on artistic integrity over commercial pragmatism presents a critical point of reflection on leadership traits and strategic adaptability within sole proprietorships. Employing qualitative methods, including SWOT and Porter's Five Forces analysis, alongside organizational behavior theories, the study guides students in assessing strategic decision-making under resource limitations. It further presents a modular business model that leverages case-specific collaboration rather than fixed employment, offering a contemporary lens into flexible organizational structures. Ultimately, this case encourages critical discourse on entrepreneurship, leadership style, and business survival in the age of digital disruption, while serving as a practical teaching tool for undergraduate and MBA-level business education.

2. Teaching Note and Syllabus

2.1 Case Objectives and Target Audience

This case is designed for discussion on entrepreneurship in uncertain environments, particularly in post-COVID and digital economies. Instructors may divide students into specific groups to simulate real-life decision-making. In this case, the study of Meijing Media's Entrepreneurial Journey is intended to be further developed into a

teaching plan applicable to both pre-university and postgraduate business education. At the A-Level curriculum level, it is suitable for subjects such as Business (9609), Global Perspectives & Research (9239), and Economics (9708). At the MBA level, the case can be integrated into core modules, including Strategic Marketing Management, Organizational Behavior, Business Decision Analysis, and Entrepreneurship & Innovation, offering rich, real-world insights to support academic learning and practical application.

2.2 Teaching Approach

This teaching case is designed to align with the following teaching outcomes, which are coordinated with the Cambridge A-Level Business (9609) and Global Perspectives & Research (9239) curricula, as well as undergraduate and four key MBA module programs. Upon completing this case, students will be able to:

- Demonstrate an understanding of enterprise formation and sole proprietorship.
- Analyze emerging flexible employment patterns in modern business environments.
- Introduce leadership styles and the Big Five Personality Traits Theory, align with organizational behavior.
- Use the theoretical concepts in real-world business decision-making.
- Understand the media industry development in different countries.
- Use SWOT, Porter's Five Forces, to assess an entrepreneurial business.

2.3 Literature Review

Critics have identified significant gaps between the required knowledge and skills for the real world of business and the acquired academic knowledge and skills through business education (Bennis and O'Toole, 2005; Pfeffer & Fong, 2004; Mintzberg, 2004). Simulation & case studies develop students' problem-solving skills similarly, but more effectively, than lectures. (Farashahi & Tajeddin, 2018) In this context, it is argued that case studies should be viewed as a preferred method for teaching a variety of concepts in science courses. (Bonney, 2015) As well, in (Sergis, 2018) research, the Flipped Classroom Model (FCM) has been repeatedly investigated in both research and practice contexts, primarily in terms of their capacity to foster students' autonomous learning and overall motivation for the learning process. This paper follows the aforementioned methodology and teaching theory to implement a bilateral communication and teaching approach in practice.

3. Entrepreneur and Startup Enterprise

The protagonist, Chen Yurong, is a local citizen of Shanghai who belongs to Generation Y. Driven by beliefs in individualism, idealism, and neo-liberalism, he resigned from his former position as a project manager to embark on a journey in pursuit of a career in the creative industry. The protagonist has a great passion for media, advertising, photography, and video editing. Meijing Media was a single-person enterprise, with stockholder Chen Yurong owning 100% of the company, which is a sole proprietorship.

Table 1: Corporate information *of Meijing Media*

Unified Social Credit Code:	91310120MA7AUG997Y
Legal Representative	Chen Yurong
Business Status	Active
Registered Capital	RMB 1 million
Registration Number	310120007368202
Enterprise Type	Limited Liability Company (Natural Person Sole Proprietorship)
Business Term	September 2, 2021 - September 1, 2051
Business Range	Film distribution; Production and operation of radio and television programs; Organizing cultural and artistic exchange activities; Advertising design and agency
Registration Address	Room 1201, Building 1, No. 258 Zhijiang Road, Fengxian District, Shanghai, China

Source: National Enterprise Credit Information Publicity System

According to the interview with Chen, he highlighted that presently his core business involves four aspects:

- Portrait Photography
- Commercial Promotional Video
- Film Crew Cinematography Director and Consultant
- Influencer Account Management and Promotion

From his perspective, the preference is for commercial promotional videos and TV advertisements. However, external issues drive him, prompting a shift in the business strategy. According to the interview, Chen focuses on combining digital promotion with physical engagement, network building, and cold calls, as well as exhibition participants. It also includes self-marketing account creation, in-store visits, fostering direct communication, and building connections. By combining a digital approach, physical visiting, and marketing, he argued that this business model focuses on creating meaningful relationships and collaboration opportunities to drive long-term growth.

4. Business Issues and Analysis

With the rapid development of the social media industry, the emerging trend of launching a media company, along with the surge of influencers, could face significant challenges. Based on the attribution theory, the business issues of Chen's company can be divided into the following aspects:

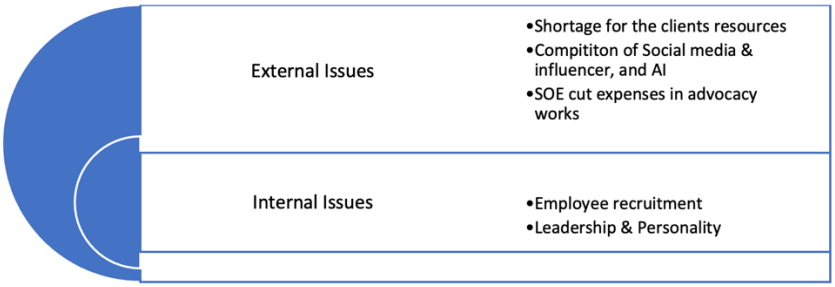


Figure 1: Matrix of Internal and External Business Issues

Chen Yurong 's business issues generally consist of external and internal factors. The following chapter will narrate these issues in detail.

4.1 Marketing Issues

Between 2020 and 2024, the number of newly registered enterprises in China exhibited fluctuating trends, culminating in a sharp decline to 27.37 million in 2024, representing a 16.38% decrease. During this period, the market value of the media industry encountered an inflection point in 2022, slowing down the increase. When comparing the value and opportunities for each enterprise, it is evident that there is much to be improved.

These shifts were influenced by COVID-19, which significantly correlated with high unemployment and triggered structural changes in the labor market. As a result, more young individuals have turned to flexible occupations, such as influencers, livestream hosts, independent photographers, and content creators. This surge in digital entrepreneurship reflects both the resilience and transformation of youth employment patterns in a disrupted economy. (Tan & Sheng, 2024)

Table 2: Increase Enterprises and Media Industry Market Value

	Increase Enterprises (Unit)	Increase Rate	Media Industry Market Value	Increase Rate
2024	27.37 million	-16.38%	Not Released	/
2023	32.73 million	12.55%	3151.82 billion	8.38%
2022	29.08 million	0.73%	2908.25 billion	-2.11%
2021	28.87 million	15.39%	2971.03 billion	17.76%
2020	25.02 million	5.26%	2522.97 billion	11.51%

Source: China Media Industry Development Report (2019-2024)

According to the China Media Industry Development Report (Cyberspace Administration of China, 2021), the latest market value of the media industry is 3151.82 billion. Nevertheless, the increase in media market volume did not match the growth of enterprises; the phenomenon was characterized by centralization, which led to market share becoming more fragile and monopolized, rather than both parties gaining increased opportunities. The tendency also includes creators who are active on short video platforms such as Douyin (TikTok in China), Kuaishou, and Bilibili, as well as self-media influencers. With the increase in newly registered media companies and the rise of self-media influencers, the media industry has faced greater competition and rivalry.

4.2 SWOT Analysis for Marketing Issues

The SWOT model is used to analyze the external and internal business comparative attributes (Nut & Backoff, 1993). In this context, with the usage of this qualitative measurement, the external marketing Issues aspect can be characterized as below:

Threat: The media industry is facing harsh competition due to the rise of social media and the emergence of independent photographers. Secondly, Chen previously worked as a project manager in a property management company. During this transitional phase of his career, he lacked an extensive professional industrial network and resources. Additionally, the shrinkage of segmentation and centralization also presented a significant threat.

Opportunity: Social media and independent photographers present both opportunities and challenges. Manager Chen's Meijing Media can also promote and advertise its business through self-account and social media. Furthermore, although the rise of influencers poses a threat, the market volume still demands photography, video editing, and content creation, which is booming, allowing Chen to attract business from self-media creators.

Weakness: Meijing's weakness is a lack of a systematic HR structure. A loosely organized sole proprietorship lacking formal management systems and embracing a one-person business model. Moreover, his leadership style hinders Meijing Media’s ability to adapt to the transition.

Strength: The essential strength of Meijing lies in the passion and sincerity of its founder, Chen. Passion in the entrepreneurial context confirms its predictive power in explaining differences in firm growth. (Iyortsuun & Shakpande, 2022)

4.3 Industry Issues

The industry issues encompass insufficient funds due to the state-owned enterprises (SOEs) system reform, as well as the Power of AI Content Generation and the revolution in the trend. The 18th National Congress of the Chinese Communist Party was regarded as a milestone for cutting administrative expenses. (Jinrong, 2018) In 2016, SOEs reduced management expenses and labor costs by RMB 12.57 billion. (Qiushi, 2017)

On the other hand, based on the advances in AI, the camera function is prone to becoming more comprehensive and automated. In this case, photographers are regarded as less important than they were before. (capture, zooming, and exposure can all be done automatically) And AI head swapping and art generation are rapidly advancing technologies. They have decreased the need for physical elements like makeup and lighting in visual production, often resulting in images that rival or surpass traditional photography.



Figure 2: AI User Portraits: Two Typical Clients of Freely Accessible AI Tools and Platforms

Note: Photos generated by Ai, and all get the permission of Portrait rights

In the meantime, this means the personal skill requirement in shooting and using a camera has been dramatically minimized. (Amankwah-Amoah & Abdalla, 2024)

4.4 Porter's Five Forces Model Analysis for Industry Issues

Although the model has attracted some criticism due to the evolving nature of the Internet economy. (Dälken, 2014) Porter's five-force strategic analysis model is widely used by strategic analysts who want to understand the competitive dynamics of an industry.

Competitive Rivals: Meijing Media has faced diversified competition from various rivals, including internet celebrities, individual photographers, and AI-generated content. Influencers on platforms, such as TikTok and Bilibili, provide low-cost, metaverse-style, and high-interaction content that challenges traditional media. (Wang, 2022) And independent photographers, benefiting from affordable equipment, competitive pricing and agility. (He & Qiu, 2022)

New Entrants in an Industry: Flexible work hours, remote co-working, and the internet have effectively lowered the barriers to entering the media industry. Additionally, movie lenses and cameras, such as the Cooke and Sony FX series, are now more focused on consumer markets, with reduced prices that make them more accessible. Furthermore, the rise of apps has enabled individual photographers to easily obtain their own business orders. Overall, these factors contribute to a decline in the barriers to entry in the industry.

Supplier Power: Chen's Companies operate both commercial and residential photography facilities. The necessary equipment, including cameras, lighting, and other tools, is all available in his home workshop. However, sponsors face uncertainty due to the market's volatility and decline.

Customer Power: In the present media and creative industry field, the customer can usually be summarized in four aspects: Self-media creators, Commercial Orders, SOE Promotional Video**,** Flat Photo. The media segmentation is now becoming severely clear. Self-media creators primarily focus on restaurant introduction, makeup and cosmetics, education, and consulting. In this regard, their revenue usually depends on the sponsors. The commercial order, manufacturing, and consumption companies all have stable collaboration partners. SOE Promotional Video sometimes encounters the same situation as commercial orders, but it is even more bureaucratic. The tendering and bidding procedure usually involves corruption and bribery. (Zhang & Yun , 2017) They have stable inbreeding, which the Protagonist Chen hardly meddles with and interferes in this domain.

Threat of Substitutes: The threat of substitutes for Meijing Media is closely tied to rapid advancements in AI and the growing use of smartphones by content creators. AI technologies can now automate tasks that were traditionally handled by professionals, such as focusing, lighting, and editing. At the same time, many influencers use smartphones and editing apps to produce high-quality content independently, reducing the need for traditional media services. These low-cost, user-friendly tools make professional photography and videography appear less essential, posing a significant threat to Meijing Media’s business model.

4.5 Employment and Human Resource Issues

The human resource management in Meijing Media's organizational structure is flexible and Imperfect. Currently, it consists of merely one employee, CEO Chen. The author asked him why he had not hired more staff to handle technical work, leaving him intently responsible for commercial and administrative tasks.

CEO Chen responded:

“If you recruit a team, your monthly expenses will be around tens of thousands. If there are cases, that's great. If there aren't, you'll still spend tens of thousands each month. Every day, you will be working for someone else, earning money to support the entire team. In contrast, when I work alone, I only need to earn 10,000 and 20,000 RMB a month to make ends meet.”

In this regard, research on the media technician market shows the labor prices for photography and video editing as follows:

Table 3: Part-Time Labor Wages in the Media Industry

Position (Part-time)	Price	Domain
Photography	699 RMB/2 hours	Family Portrait
Photography	850RMB/ hour	Wedding
video editor	100/hour	Video Making
MAKE-UP Artist	800/day	Make up

Source: Outsource platform information: MyWed, Hunliji

Table 4: Full-Time Labor Salaries in the Media Industry

Position (Full-time)	Price	Domain
Photography	12000RMB/month	Fashion & Clothing
Photography	13500 RMB/month	Children Portrait
video editor	11000RMB/month	Products, Edit, Public Account Operation
MAKE-UP Artist	7500 RMB/month	Cosmetic, make-up

Source: Boss-Recruitment App

In this case, according to the labor force expense and the uncertainty of business case, Chen withhold his opinion for working individually, as neither has the capability nor the need to hire a full-time employee. The new model he prefers is a "Case-Orientation" pattern.

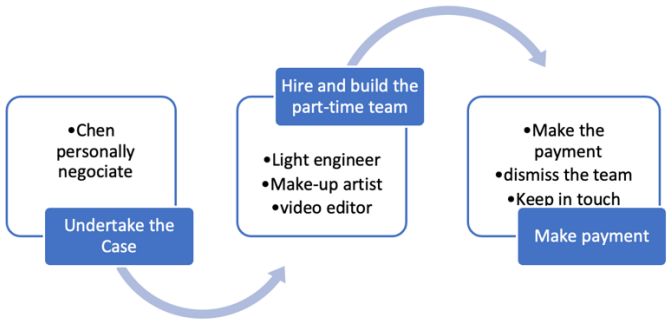


Figure 3: Employee Structure Based on Chen Yurong's Case-Oriented Model

Source: Content was summarized from the interview

4.6 Other Information Related to the Case Problem

Through business decision-making and leadership assessments, organizational behavior is a dimension which widely used in business management, especially in relation to the Big Five personality traits. (Hassan & Asad, 2016) In terms of leadership style, many of the prominent leaders have the personality and characteristics of charismatic leaders or even Narcissists. (Rosenthal & Todd , 2006) Donald Trump, Elon Musk, and others are all regarded as having this type of personality.

However, the Overconfidence and Refusal to take advice, somehow is risky for the startup company and entrepreneurs.

Table 5: Big Five personality traits and Description

Dimension	Type	Description
O	Openness to Experience	Curiosity, creativity, and openness to new experiences and ideas.
C	Conscientiousness	Degree of organization, responsibility, and self-discipline.
E	Extraversion	Level of sociability, energy, and enthusiasm in social interactions.

Dimension	Type	Description
A	Agreeableness	Tendency to be cooperative, trusting, and altruistic.
N	Neuroticism	Emotional stability and susceptibility to negative emotions.

A complex interplay of personality traits and operational strategy shapes Chen Yurong's leadership style. According to the Big Five personality traits, Chen acknowledges that his strengths in interpersonal communication and relationship management make him more naturally suited to film production rather than technical roles. However, his tendency toward neuroticism presents a significant internal weakness in business decision-making. He also admits that his rigidity in making decisions may hinder Meijing Media's adaptability and future growth. Still, he believes that entrepreneurs must possess strong willpower and determination. Early studies on entrepreneurship suggested that passion helps individuals cope with the challenges of entrepreneurial pursuits (Baum & Edwin A., 2004) In this case, certain personality traits can act as a double-edged sword.

5. Conclusion

The Meijing Media's case offers a multifaceted angle on the realities of entrepreneurship in China's emerging creative industry. In the same time, the business Issues of this company mainly encompass entrepreneurship, business, and industry aspects. Chen Yurong's entrepreneurial journey reflects both the resilience and the risks associated with acting as a sole proprietor. The case highlights that success in the media industry is no longer defined solely by technical skill or artistic integrity, but increasingly by adaptability, strategic planning, and resourcefulness.

Furthermore, the theory and methodology not only focus on SWOT and Porter's Five Forces but also incorporate the Flipped Classroom Model (FCM), Organizational Behavior theory, and attribution theory to explore the case study and qualitative research.

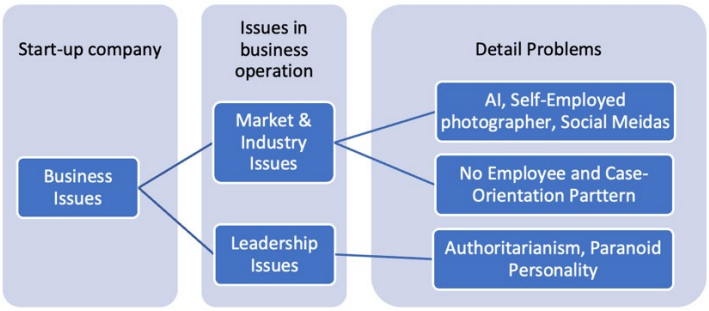


Figure 4: Summary of Key Business Challenges Faced by Meijing Media

This case also further helps business and entrepreneurship students consider how personal beliefs, market changes, and new AI technologies impact a business's success. It also encourages students to understand the real-life challenges entrepreneurs face and the complex business decisions they must make.

In addition, the article also presents an innovative approach to thinking and a method of depiction that combines qualitative research with practical applications in real-world business interviews. It aims to provide insights and references for business management curricula and MBA courses.

6. Case Teaching and Business Interview Tactic

6.1 Teaching Note and Research Approach Usage

This case is designed for both researchers and lecturers to better understand entrepreneurship in the emerging media industry, the research approach usage and core teaching note can be summarized as below:

- Data collection & Accuracy of data sources - **Table 1:** *Increase Enterprises and Media Industry Market Value*
- Interview Skill – profile interview in research and report
- Business Decision making – use SWOT, Porter Five, analyze business environment and issues
- Enhance the analysis by incorporating insights from organizational behavior

6.2 Case Questions for Students:

- What are the strengths and weaknesses of Meijing Media has in current business operation?
- How do technological advancements like AI design and content generation impact the industry?
- How do Chen's characters traits influence his business decision making and orientation?
- What strategy would you give to Chen's company for business prospects over the next 5 years?

6.3 Business Interview Tactic

- Interview transcripts: When conducting interviews, it is important to get consent and record. This includes not only verbal agreement but better with a written or digital consent form.
- Pre-Interview working: in advance prepare the industrial data for reference, draft the outline, questions, and your purpose.
- Emotional Management Skills: Know how to console. For example, Chen said**, "***Why does everyone have their own obsessions deep? It's just a matter of whether they choose to express them and share them with others. You know I don't care anything, and I don't bother with it."* In such moments, the ability to calmly acknowledge emotions and gear the conversation forward becomes more important.

6.4 Lessons Learned and Application in Emerging Market Education

The case and storytelling of Meijing Media are particularly valuable for teaching students about entrepreneurship in real-world environments, such as China's digital creative industry sector, the new-era influencer economy, and the booming epoch of independent media and content creation. It highlights the mentality and qualities that a successful entrepreneur should possess, including resilience, thoughtful planning, adaptability, and strong leadership. Teachers can use this case in lessons on business innovation, digitalization, and entrepreneurship training, especially in the emerging markets that face similar technological and structural challenges.

Ethical Declaration

This study involved interviews with human participants and received ethical approval from the relevant institutional ethics committee. Informed consent was obtained from all participants prior to data collection.

AI Declaration

This paper utilized an AI tool (ChatGPT by OpenAI) to assist in matching business subjects, refining language, checking grammar, and enhancing the clarity of expression in specific paragraphs.

The author entirely developed the ideas, structure, analysis, and academic content. The AI-generated suggestions were only served as a reference and edited to ensure alignment with the intended meaning and academic integrity of the paper.

Declaration of Originality and Exclusive Submission

I hereby declare that the manuscript with the title *"Pragmatic Teaching and Case Study for Business Management: Business Analysis of Meijing Media's Entrepreneurial Journey in China's Emerging Media Industry"* is my original work and has not been published previously, in whole or in part, in any journal, book, or other academic outlet.

Furthermore, I affirm that this manuscript is not under consideration for publication elsewhere and will not be submitted to another journal while under review by your publication.

All authors have read and approved the manuscript and have agreed to its submission to your journal.

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Cultural Intelligence, The Key to a Successful Employee: From Monoculture to Interculturality in Contemporary Organizations

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Abstract: The context in today's society is characterized by an accelerated evolution of technology, means of communication, globalization, the dissolution of state borders, migration and intercultural partnerships, so that multicultural teams are both a constant and an imperative for the functioning of organizations. In light of these developments, intercultural sensitivity (IS) (Bennett, 1993) and cultural intelligence (CQ) (Ang, Dyne and Koh, 2006) have emerged as essential sets of skills for effectively navigating and adapting to these transformations. These skills include adaptability, openness to new experiences, an understanding of the values of different cultures, flexibility, empathy, impartiality, and the ability to adapt to diverse cultural contexts. This paper presents a comprehensive review of both conceptual and empirical studies on how workforce diversity is or can be managed. Consequently, the analysis presents the stages of evolution of intercultural sensitivity - monocultural orientation (denial, defense), the transition stage (minimization) and global orientation (acceptance, adaptation, integration), and how it can evolve into cultural intelligence. The findings of the studies suggest that cultural exposure plays a crucial role in the emergence and development of both abilities. It is essential to acknowledge that not all intercultural interactions facilitate this development. The impact of these experiences is influenced by various factors, including the nature and duration of the interactions, as well as the individual's commitment to understanding and leveraging those experiences effectively. Personality traits were also considered important, with extroversion, agreeableness, conscientiousness, and openness being linked to a greater willingness to engage in intercultural interactions, as well as a higher level of intercultural skills, IS, and CQ. Bennett's linear model of evolution (1993) serves as a foundational framework for comprehending the development of IS. This analysis, however, introduces an alternative perspective that more closely reflects the lived experiences of individuals involved in the process. Thus, the nature of intercultural interactions, along with individual differences, can contribute to non-linear evolutionary processes and, in certain instances, may even lead to involution. This analysis enhances understanding of how to cultivate and manage intercultural sensitivity and cultural intelligence at the organizational level. The study's findings contribute significantly to the literature and offer a framework for developing effective strategies and initiatives for managing cultural diversity, essential for navigating today's dynamic environment.

Keywords: Intercultural Sensitivity, Cultural Intelligence, Cultural Exposure, Globalization, Workforce Diversity

1. Introduction

In today's society, cultural diversity has become a daily reality because of the fact that “we live in a flat world” (Friedman, 2009, cited Sousa and Gonçalves, 2017, p. 90). The rapid technological advancements, the dissolution of state borders (Dusi, Messetti and Steinbach, 2014), the evolution of the economy from a local, national level to global markets, the development of franchise chains, and increased migration have fostered cultural exposure. Moreover, intercultural partnerships have developed in response to organizations' necessity to adapt to evolving economic trends and their aspirations for growth (Sousa and Goncalves, 2017). According to Giddens, we live in a fluid society, as globalization causes global processes to affect local social reality and vice versa (Giddens, 1991).

As a result of transnational partnerships, the merging of different organizations, and labour migration, we are experiencing a significant increase in diversity within the workforce as well as among customers, partners, and collaborators. This diversity encompasses various factors, including ethnicity, religion, cultural norms, and the languages spoken (Seymen, 2006). Consequently, intercultural teams are both a prevalent feature of modern organizations and an imperative for their successful operation. Given this ever-changing reality, employees and organizations must reconsider how they relate to the interactions and social contexts in which they are placed and adapt, as much as possible, to new trends (Yeke and Semercïöz, 2016)

In research and practice in the field of intercultural management, the interaction between systems of norms and values, communication, and action models from different cultures has been conceptualized as conflictual. This perspective is dominant in the specialized literature and is based on the transnational comparison model proposed by Hofstede (1980 cited in Thorrold, 2016), which assumes that a culture is unique, does not change over time, and contact with another culture generates negative effects embodied in costs (time, energy, money, etc.).

Thorrold proposed a synergic, complementary perspective that views cultural differences as valuable resources that, when effectively utilized, "can create a competitive advantage" (2016, p. 1878). By harmonizing various cultural elements within a hybrid structure, organizations can foster innovation, which is crucial for adding value and achieving success in a rapidly changing society. Empirical evidence has shown that the latter perspective is a much better predictor of the outcomes and effects of intercultural interactions, compared to the conflict approach, which does not take into account individual, situational differences and the fluid nature of cultural phenomena and elements (Thorrold, 2016). In support of this theory, studies show that organizations can use cultural diversity as a competitive advantage (Thorrold, 2016, Kulkarni, 2012), when managed effectively and can have a higher success rate in the market, especially in international projects (Matthews and Thankkar, 2012). The observed positive consequences include an enhanced ability to recruit and retain talent, improved problem-solving through diverse perspectives (Mazur, 2010), better alignment with the expectations of various customer categories (Adler, 1991 cited in Kulkarni, 2012), and greater adaptability to change (Morgan, 1989 cited in Kulkarni 2012).

Taking into account the large-scale metamorphoses in society, presented previously, as well as in relation to Thorrold's theory (2016), in order to understand how organizations can adapt and survive in the market, the present analysis aims to present and discuss some key concepts in intercultural management. Therefore, intercultural sensitivity (IS) (Bennett, 1986), intercultural competence (Byram and Zarate, 1997), cultural intelligence (CQ) (Ang, Dyne and Koh, 2006) and cultural exposure (Crown, 2008) are four interconnected concepts whose significance and applicability I will further discuss. Additionally, this study aims to address the following research question: *How can intercultural sensitivity and cultural intelligence be effectively developed and managed at the organizational level?*

2. Literature Review

2.1 Theoretical Framework

2.1.1 Intercultural Sensitivity

Intercultural sensitivity is "the experience of cultural differences, an experience that is dependent on the way a person constructs that difference" (Bennett, 1993, p.53). In other words, IS refers to the attitudes, ideas, and reactions that individuals have towards individuals different from them. According to his conceptualization, people with a high level of intercultural sensitivity (IS) adopt an ethnorelative approach, while those with a low level exhibit an ethnocentric perspective.

Bennett (1993) built a model of the development of intercultural sensitivity (DMIS) that is based on the premise that this quality is not innate, but acquired through lifelong exposure to various behavioral models, perspectives, lifestyles, cultures, value systems, and social realities. Moreover, exposure is not sufficient to achieve IS, but must be complemented by an objective, ethno-relativist analysis and understanding of these realities (1993). Thus, if the individual was introduced to a new culture, but did not analyze the cultural elements and characteristics of that community, this experience will not contribute to the evolution of their level of IS. Given this perspective, Bennett proposes an evolution of IS that can be analyzed in three stages: monocultural orientation, transitional stage, and global orientation.

Table 1: The development model of intercultural sensitivity

Stage	Sub-stages	Definition	Examples
Monocultural orientation	Denial	Involves identifying a single reality and the inability to perceive cultural differences, <<individuals perceive themselves as more "real" than others - to the point where others may not even seem fully human>> (p.3).	A company at this stage may experience difficulty in solving conflicts because internal policies are insensitive to cultural differences.
	Defense	People perceive, identify cultural differences, but relate to the dichotomy of us-them, good-bad, and consider that these are the basis of the problems facing society.	Belief in the supremacy of the white race over other races (race hatred).
Transitional stage	Minimization	A neutral stage, one of tolerance, in which cultural differences are masked and similarities are highlighted, and contact with "others" is reduced to a minimum.	The belief in equal opportunities for employees often leads to frustration and conflicts

Stage	Sub-stages	Definition	Examples
			when the reality of the dominant culture emerges.
Global orientation	Acceptance	Individuals recognize that there may be cultures as complex as their own, but do not necessarily resonate with them, considering that they "are not good or bad, they simply are" (p. 5).	Although organizations may have policies that promote inclusion, there is no training in understanding cultural differences.
	Adaptation	Individuals can adapt to intercultural contexts; they can “experience the world as if they were part of a different culture” (p. 5), while still prioritizing their own culture.	A company that has reached this stage will not require a Muslim person to adhere to a dress code that requires wearing a skirt.
	Integration	At the highest level of ethnorelativism, individuals see other cultures as equally valuable to their own and can collaborate effectively with them.	A company will combine the ideas of several groups, as it understands that this synergy can generate added value.

(Bennett, 2017)

According to Bennett (1993), DMIS is linear and progressive and Perry and Southwell (2011) claim that "each stage is moving deeper to a level of intercultural sensitivity" and "as each person experience or understanding of cultural difference became more complex, his/her potential for intercultural competence increases" (p. 454). Consequently, this viewpoint aligns with the approaches of certain researchers (Moore-Jones, 2018; Straffon, 2003), who suggest that IS serves as the foundation for further developing intercultural competence (IC).

However, Perry and Southwell (2011) question the progressivity and linearity of DMIS, highlighting individual differences in this evolution. According to their perspective, individual differences can give rise to diverse evolutionary patterns. The duration of each developmental stage may vary among individuals; some may bypass certain stages entirely, while others may experience involution because of the fact that the experiences they live have a high degree of complexity, and there is no fixed pattern. In support of this idea, Moore-Jones (2018) posits that individuals could be observed at different stages of evolution, contingent upon the specific context in which they are situated.

2.1.2 Intercultural Competence (IC) and Cultural Intelligence (CQ)

I previously noted that intercultural sensitivity is seen as the understructure of intercultural competence. Consequently, it is important to establish a clear conceptual distinction between the two in order to enhance understanding. Intercultural sensitivity (IS) is described in the literature as an internal phenomenon that refers to individuals' evaluations and attitudes toward cultural differences (Poort, Jansen and Hofman, 2023). Intercultural competence involves the actionable aspects: the ability to interact and live with cultures different from one's own (Guiheme, 2007), to have dual perspectives (Byram and Zarate, 1997), respect for those who are different, behavioral flexibility, and the necessary skills for managing intercultural interactions (Moore-Jones, 2018).

A high level of intercultural competence can underpin the development of cultural intelligence (CQ), which involves a more advanced set of skills and is described as ‘’a person’s capability to adapt effectively to new cultural contexts.” (Earley and Ang, 2003) by establishing frames of reference to understand specific cultural contexts and translating them into suitable reactions and behaviors (Poort, Jansen and Hofman, 2023). CQ is considered an advanced form of IC, as both share foundational components but differ in intensity, allowing for their interchangeable application (Poort, Jansen and Hofman, 2023). Therefore, in order to improve clarity and fluidity in the analysis, I will refer to this ability as cultural intelligence.

Cultural intelligence is a multidimensional construct comprising four sub-dimensions, which differs from one person to another in weight and intensity: cognitive, metacognitive, motivational, and behavioral. These sub-dimensions are defined and explained in the table below.

Table 2: Components of cultural intelligence

Sub-dimension	Explanation
Cognition	It involves knowledge of the norms, values, and practices of different cultures.
Metacognition	The capacity to understand the meaning of cultural differences and build an effective strategy to respond to them.
Motivational	Interest, motivation to adapt to cultural differences, and to function effectively in multicultural contexts.
Behavioral	The ability to act appropriately in specific multicultural contexts.

(Earley and Ang, 2003)

2.1.3 Cultural Exposure

In the discussion of IS and CQ an important factor is exposure, which Crown (2008) defines as ''experiences related to a region that aid in developing a familiarity with or understanding of the norms, values, and beliefs of that region" (p. 393). In support of this idea, the findings of Sousa and Gonçalves' study show that expats have a higher level of CQ compared to non-expats (2017). According to Crown (2008) and Moore and Jones (2018), not every cultural contact contributes to the development of the two characteristics, as they differ in importance and duration. Traveling to different countries or watching foreign news programs does not have as strong an impact as moving to another country or traveling for business. Moreover, exposure does not seem to be sufficient; it must be accompanied by the individual's motivation to internalize and capitalize on that experience (Bennett, Janet M. and Bennett, Milton J, 2001; Yeke and Semerciok, 2016). Last but not least, cultural contact can enhance or hinder abilities depending on the characteristics of the context in which the individual is put (Benet-Martines and Oishi, 2008). Cultural exposure is associated with: a better understanding of cultural differences (Chen and Isa, 2003), the adoption of appropriate behavior, and better adaptation in the host country (Early and Ang, 2003), building trust in project teams (Wong *et al.*, 2008), intercultural competences and language proficiency (Poort, Jansen and Hofman, 2023).

2.1.4 Previous Research

Prior studies have linked IS and CQ to several characteristics that are crucial for organizational functioning and success in the current environment. Possessing those abilities favors adaptation to culturally diverse contexts, encourages creativity (Livermoore, 2011; Liu, Chen and Yao, 2011) and improves conflict and team management (Gonçalves et al., 2015). CQ is also associated with positive attitudes such as life satisfaction, passion for work (Sousa and Gonçalves, 2017) and high performance (Thorrold, 2016). Moreover, according to Early (2002), ''high CQ team member is more readily able to provide the types of behaviors and actions needed to maintain a productive multinational team environment." (p. 290).

Individuals with high levels of CQ generally have a higher level of flexibility and adaptability, communication skills, and confidence in multicultural interactions (Early and Ang, 2003), they are extroverted, open to new experiences, exhibit an ethnorelative attitude (Leong, 2007), emotionally stable and culturally empathetic and have a high level of language proficiency (Sousa and Gonçalves, 2017). The Latter is considered both an antecedent and a mediator of CQ (Poort, Jansen and Hofman, 2023).

Some studies that aimed to measure CQ have concluded that personality is an important factor in the emergence and development of CQ. Ang, Dyne and Koh (2006) measured the relation between personality traits from the Big Five Inventory and the four sub-categories of CQ and revealed positive associations between consciousness and metacognitive CQ, neuroticism and agreeableness with behavioral CQ, and openness with all four sub-dimensions. Moreover, personality traits have a contribution on intercultural communication (Bennett, 1998), with extrovert and open individuals having a high level of intercultural communication skills (Ramalu et al. 2010) and CQ (Duff, Tahbaz and Chan, 2012). This finding emphasizes the significance of individual personality traits in understanding and enhancing one's ability to navigate diverse cultural environments effectively (Poort, Jansen, and Hofman 2023).

2.2 The Metamorphosis of Organizational Strategies

Cultural diversity is an increasingly defining characteristic of today's organizational environment and society as a whole. According to Kulkarni (2012), the more culturally diverse a company is, the higher it scores on a number of specific indicators. These include: the ability to recruit and retain talent, a high ability to solve problems based on their distinct perspectives (Mazur, 2010), to meet the expectations of diverse customer groups (Adler, 1991, cited in Kulkarni, 2012), and to adapt easily to change (Morgan, 1989, cited in Kulkarni, 2012).

Historically, large organizations have often expected individuals from minority cultures to conform to the majority group's norms (Kulkarni, 2012, p. 267). This has led to a devaluation of cultural differences. However, the rise of globalization and the influence of movements advocating for equality and anti-discrimination have prompted a reassessment of cultural diversity. Recognizing the importance of embracing cultural diversity is now essential for fostering inclusive and effective organizations.

To effectively address diversity management needs, professionals from fields such as sociology, psychology, and education have developed theoretical frameworks that enhance our understanding of emerging trends. These frameworks have transformed perceptions of diversity, leading to strategies and policies that promote inclusion and appreciation of cultural differences (Bennet, Janet M. and Bennett, Milton J., 2001). Consequently, fostering cultural intelligence has become a key objective in many initiatives.

According to a recent study by the Economist Intelligence Unit, the majority of managers in the 68 countries surveyed recognize that intercultural management is a priority challenge on their agenda (Livermore and Van Dyne, 2015). However, identifying and accepting the challenge does not necessarily mean that they are prepared to deal with the new trends generated by a fluid society. Therefore, change must start from management, which, according to Barker (2015), has the responsibility to convince and motivate employees to recognize, understand, and respect cultural differences, as well as to develop their intercultural skills. The Coca-Cola Company acknowledges the significance of cultural intelligence as an essential competency for leaders in global markets. This skill enables leaders to adapt their operations to meet the cultural nuances and expectations of their audiences. Additionally, the company emphasizes the importance of developing this competency among all employees, as it is believed that “hotel and restaurant managers are more likely to form an opinion of the company based on the intercultural competence of the delivery driver rather than that of the general manager” (Livermore and Van Dyne, 2015, p. 18). This attitude is based on the belief that “Cultural intelligence is a critical skill for navigating today’s increasingly global and diverse business environment” (Mortiz, cited in Livermore and Van Dyne, 2015, p. 2).

3. Discussions

This review aimed to present current perspectives on intercultural sensitivity, cultural intelligence, and cultural exposure against the backdrop of the accelerated metamorphoses in organizations that we are witnessing.

I agree with the perspective of the researchers presented (Moore-Jones, 2018; Straffon, 2003), according to which IS, the cognitive, attitudinal component, serves as a starting point for the subsequent development of CQ, the behavioural component. In this context, cultural exposure (Crown, 2008) functions as both a mediator between the two stages and an important factor in amplifying the two abilities.

While Bennett's (1993) theoretical model, with its focus on linearity and progressiveness, provides valuable insights into the formation and development of IS and CQ, I find that the perspective offered by Perry and Southwell (2011) aligns more closely with the current realities observed in organizations and the labor market. In other words, I do not dispute that evolution is linear in many cases, but individual differences can have a decisive influence on its dynamics. Individual differences can be understood through personality traits, cultural background, type and duration of cultural exposure, and how the individual interprets these experiences. In the following sections, I will explain and analyse these individual differences for greater clarity.

Regarding personality traits, studies have concluded that traits such as extroversion, agreeableness, neuroticism, and openness contribute to the emergence and development of IS (Bennett, 1998), CQ (Ang, Dyne and Koh, 2006; Duff, Tahbaz and Chan, 2012), as well as intercultural communication skills (Ramalu et al., 2010). In other words, individuals who possess these traits have a greater potential to adapt and perform effectively in intercultural interactions and to internalize these experiences, which will subsequently lead to the development of IS and CQ. At the organizational level, these conclusions can be used by management to make decisions

regarding hiring individuals or building work teams, especially for international projects, which could lead to increased efficiency.

The cultural background of origin could be an important factor in the emergence and development of IS and CQ, and I will support this premise with some examples. Individuals from Western Europe tend to exhibit a greater openness to change. This ethno-relativist attitude can be attributed to the region's high level of societal development, which has facilitated a substantial influx of immigrants and, consequently, has fostered a rich cultural diversity. In contrast, Eastern Europe comprises several developing countries, leading to fewer emigrants and limited opportunities for intercultural interactions. This situation may result in greater conservatism and ethnocentrism, along with reduced intercultural skills. Consequently, individuals may be more susceptible to culture shock, which can lead to an involution regarding IS and CQ.

In examining intercultural interactions, I align with Crown (2008) and Moore and Jones (2018), who assert that not all cultural exposure fosters intercultural sensitivity (IS) and cultural intelligence (CQ). Long-term experiences—such as studying abroad or participating in delegations—typically yield greater benefits than short-term encounters like vacations. Moreover, I believe that not only is the type and duration of the exposure important, but also the resources that individuals have at their disposal to capitalize on that experience. Managers should prioritize providing employees involved in intercultural interactions with the necessary resources and support to maximize benefits, such as language courses and intercultural training. Last but not least, it is important to note that mere exposure to intercultural experiences is not enough (Bennett, Janet M. and Bennett, Milton J, 2001; Yeke and Semerciok, 2016). Such exposure should be reinforced by the motivation of individuals to internalize and derive significant benefits from these experiences. This is where the importance of understanding and effectively managing individual differences comes into play.

The outcomes of prior research have underscored the relationship between IS and CQ with various variables that are vital for achieving organizational success. These refer to life satisfaction, passion for work (Sousa and Gonçalves, 2017), high performance (Thorrold, 2016), a higher level of flexibility and adaptability, communication skills, and confidence in multicultural interactions (Early and Ang, 2003), an ethno-relative attitude (Leong, 2007), a high level of language proficiency (Sousa and Gonçalves, 2017). Research (Thorrold, 2016, Kulkarni, 2012) indicates that effective management of cultural diversity can provide organizations with a competitive advantage, improving indicators as recruitment efficiency and stakeholder collaboration. Therefore, managing cultural diversity as well as developing IS and CQ should be on the list of priorities in the current context.

In the current context, it is imperative to prioritize the effective management of cultural diversity and the enhancement of cultural intelligence (CQ). I concur with Barker's perspective that initiatives and changes should be spearheaded by management. It is crucial for leadership to foster an environment where employees are encouraged to comprehend and appreciate intercultural differences, thereby facilitating the development of their intercultural competencies. This approach is a vital first step in transitioning from a monocultural to an intercultural orientation.

The present study represents a systematic review of the literature in the field of cultural diversity, which aims to provide a better understanding of how intercultural sensitivity and cultural intelligence can be developed and managed at the organizational level. The findings of this study contribute to the field's literature and offer a valuable framework for management to formulate strategies and initiatives for the effective management of cultural diversity. This approach is essential for successfully navigating the challenges of today's dynamic environment.

Ethics Declaration

In undertaking this study, I maintained strict adherence to the principles of academic integrity, ensuring that all sources were cited following the Harvard referencing style.

AI Declaration

The only AI tool utilized in this work was Grammarly, which was used solely to correct spelling errors.

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The Role of Cultural and Creative Industries as Drivers of Innovation in Strengthening Morocco's Cultural Diplomacy and Soft Power

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Abstract: In a globalized world marked by a race between countries for greater influence, innovation capacity, and economic productivity, Cultural and Creative Industries (CCIs) are now establishing themselves as powerful strategic levers for the socio-economic development of nations, and key drivers of innovation and influence in the service of cultural diplomacy and their soft power.The objective of this article is to examine how innovation in its various and multiple dimensions within Moroccan CCIs can play a fundamental role in strengthening Moroccan cultural diplomacy and soft power. The research addresses the following central question: to what extent do multidimensional innovation dynamics within the Moroccan Cultural and Creative Industries ecosystems contribute to strengthening Moroccan cultural diplomacy and Morocco's soft power on a global scale? Adopting an exploratory approach, this qualitative research relied on a triangular methodological approach combining a literature review focused on institutional and governmental reports and studies, case studies, an international benchmark of best practices in the field and semi-structured interviews conducted with institutional actors, professionals and experts in cultural diplomacy and CCIs. This research highlighted Morocco's growing interest in its innovative CCIs ecosystem and the diversity of partnerships established within this framework for the country's cultural influence. It identified the strategic role that innovative CCIs can play in strengthening Moroccan cultural diplomacy, while addressing the multiple challenges in this regard and identifying the structural, organizational, and other barriers that hinder the full deployment of this ecosystem of cultural and creative innovation and entrepreneurship. The results of our research also allowed us to schematize in an integrative conceptual model the interactions between innovation, CCIs, cultural diplomacy and Morocco's soft power, by clarifying the main development levers to be implemented to increase the innovation potential of CCIs as driving forces in order to consolidate Morocco's soft power through cultural diplomacy focused on innovation.

Keywords: Cultural and Creative Industries, Innovation, Cultural Diplomacy, Soft Power, Entrepreneurial Ecosystems.

1. Introduction

In a hyperconnected and ultra-competitive global context, cultural diplomacy has become a powerful vector of influence for countries and an essential tool for positioning themselves on the global stage and strengthening their soft power and international cultural relations. Cummings defines cultural diplomacy as "the exchange of ideas, information, art, and other aspects of culture between nations and their peoples in order to promote mutual understanding" (Cummings, 2003, p.1).

Like other countries around the world, Morocco has also placed paramount importance on its cultural diplomacy and the role that CCIs can fully play in this context. In this context, the Special Commission on the Development Model (CSMD) advocates in its General Report " encouraging the development of innovative cultural initiatives through the professionalization of the cultural sector and improved access to public funding as well as quality support " (SCDM, 2021, p.25). It also called for " promoting and energizing innovative cultural and media production that contribute to the debate, raise awareness, and drive Morocco's international outreach; and finally " (SCDM, 2021, p.25). It should be noted in this context that these recommendations align with global trends and emerging best practices in the governance, structuring, investment, promotion, and development of innovative CCIs in order to increase their influence and strengthen their cultural soft power on the international stage.

Although CCIs in Morocco constitute strategic and priority sectors and also possess strong creative potential and significant socio-economic impact, their role as powerful drivers of innovation still presents challenges that should be addressed in order to increase Morocco's international visibility on the global cultural diplomacy stage.

The objective of this article is to explore how CCIs, as drivers of innovation, can actively contribute to strengthening Moroccan cultural diplomacy by identifying innovative development opportunities within the framework of a holistic, strategic, and integrated vision for strengthening Morocco's soft power. This article also aims to examine the various challenges and obstacles limiting the innovative potential of Moroccan CCIs. The objective is to propose strategic recommendations within the framework of a synthetic and global conceptual model to overcome these obstacles and enable the CCIs to fully play their central and innovative role in strengthening Moroccan diplomacy and cultural influence. The central question of this research is therefore: to

what extent can an innovative and efficient CCIs sector play a fundamental role in strengthening Moroccan cultural soft power and modernizing Moroccan cultural diplomacy on a global scale?

Thus, after defining the CCIs in relation to cultural diplomacy, we addressed the context of the CCIs in Morocco and their role in strengthening cultural diplomacy. We then identified the challenges and constraints limiting their structuring impact at this level, before concluding with major recommendations aimed at increasing the innovative potential of the CCIs as strategic levers for strengthening Moroccan cultural diplomacy and soft power.

2. Theoretical Framework and Research Methodology

2.1 Theoretical Framework

Focusing our reflection on the role of cultural and creative industries as drivers of innovation in strengthening Morocco's cultural diplomacy and soft power, we adopted a holistic and combinatorial approach to analyze the interactions and dynamics between different cultural and creative actors. To this end, we mobilized the triple helix model of Etzkowitz and Leydesdorff (2000) which emphasizes active relationships and dynamic interactions between academia, industry and government to promote entrepreneurship, innovation and economic growth in a knowledge-based economy, in addition to the quadruple helix model of Carayannis and Campbell (2009) which integrates civil society as the additional fourth helix. We also used Howkins' (2013) creative economy theoretical framework and Throsby's (2008) concentric circles model of cultural industries to examine the role of Moroccan CCIs as catalysts for growth and vectors of soft power and identify the levers of export and diplomatic influence of Moroccan cultural and creative sectors. We also adopted Joseph Nye's soft power theory focusing on attraction and persuasion through intangible power resources such as culture, ideology and institutions (Nye, 2021, 1990) and providing a framework for understanding how cultural innovations become tools of influence and soft power on the international scene.

2.2 Research Methodology

This qualitative research, carried out in the little-explored field of Moroccan cultural diplomacy in interaction with innovation and CCIs, has been completed according to a triangular methodological approach combining a literature review focused on institutional and governmental reports and studies, case studies, an international benchmark of best practices in the field and semi-structured interviews conducted with thirty five institutional actors, professionals and experts in cultural diplomacy and CCIs. By opting for an exploratory and qualitative approach, we treated innovation in CCIs as a complex and multidimensional phenomenon requiring a holistic vision according to a systemic approach to understand the different facets of the role of innovative CCIs in strengthening Moroccan cultural diplomacy by favoring the in-depth understanding of the dynamics, perceptions, perspectives carried by the main actors intervening in the ecosystems of Moroccan CCIs. This methodological triangulation allowed for the mitigation of certain constraints and potential limits inherent in our qualitative and exploratory approach such as time constraints, partial access to certain data and thus strengthen the robustness of the results obtained which are specific to the studied Moroccan context.

3. Cultural and Creative Industries (CCIs): Innovative and Powerful Drivers of Growth and Soft Power at the Service of Cultural Diplomacy

Cultural diplomacy has become a fundamental lever of influence, establishing itself as a growing field of study within the framework of international relations and soft power. Within this framework, Cultural and Creative Industries (CCIs) play a central role as powerful tools for projecting a country's image and promoting its cultural values internationally. As O'Connor (2010) has argued, scholarly discussions of culture industries generally date back to the 1940s when Theodor Adorno and Max Horkheimer first coined the term in 1947. Indeed, as Férnandez (2021) points out, "Culture is linked to cultural diplomacy and soft power because of the need for coexistence of the different communities, territories and nations in our global village" (p.32).

This demonstrates the fundamental role that CCIs can play in promoting and disseminating national culture, dialogue, and cultural exchange. They thus foster an environment conducive to cultural cooperation, influence, and dissemination. This is why CCIs have a very close relationship with cultural diplomacy and influence.

CCIs are a strategic driver of employment, economic growth, and innovation, and have positive economic effects. As confirmed by OECD (2022), "They spur innovation and are a source of creative skills with strong backward

and forward linkages in the economy" (p.3). As defined by UNESCO (2015), CCIs are activities "whose principal purpose is production or reproduction, promotion, distribution or commercialization of goods, services and activities of a cultural, artistic or heritage-related nature." (p.11). For UNESCO (2022), "The cultural and creative sectors account for 3.1% and of global GDP 6.2% of all employment" (p.3).

As shown in the following figure, UNESCO has produced a conceptual framework that groups together the areas covered by CCIs. These include cultural and natural heritage, performance and celebration, visual arts and crafts, books and press, audiovisual and interactive media, design and creative services. It has also included tourism, sport and recreation as related domains.

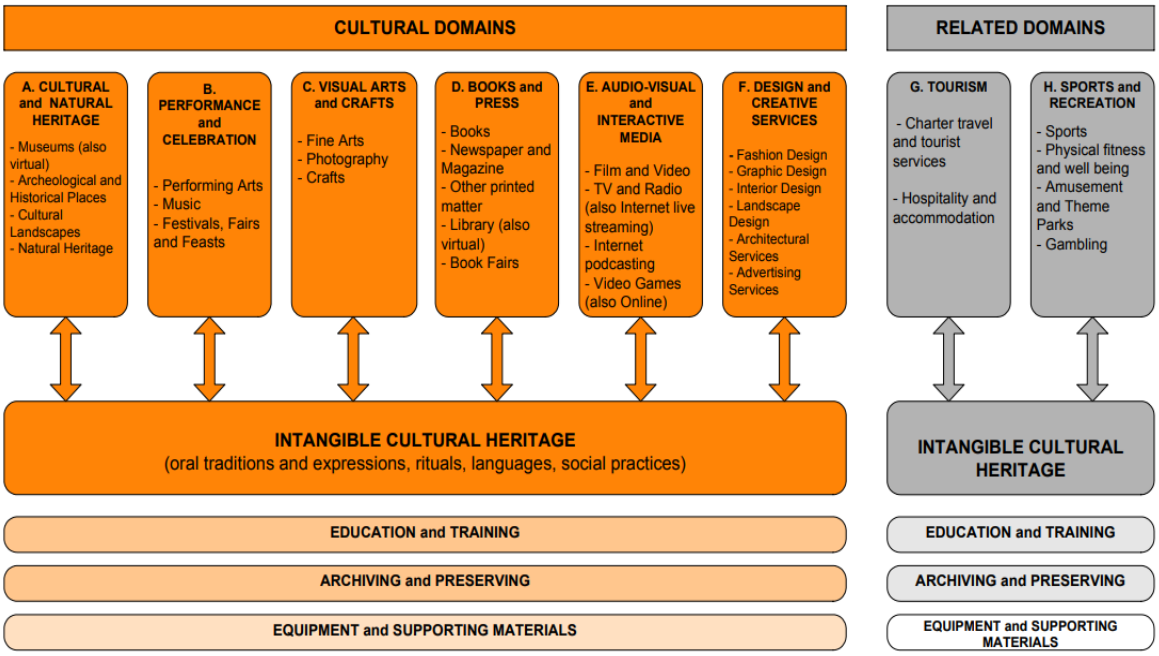


Figure 1: The UNESCO Framework for Cultural Statistics (UNESCO-ISU, 2009, p.24)

According to GIZ (2024), although definitions vary depending on the context, country, and the heterogeneous landscape of CCIs, they share common characteristics. These include their diverse nature, marketability, symbolic and functional value, tangible and intangible inputs, and the creative act (GIZ, 2024).

Furthermore, several scientific studies have highlighted the crucial importance of digital technologies and their structuring impact on CCIs (Ortiz-Ospino, L., González-Sarmiento, E., & Roa-Perez, J., 2025). Other international organizations such as UNCTAD have emphasized the modernizing and professionalizing characteristics induced by the considerable growth of what it calls Creative Industry 4.0 (UNCTAD, 2021).

Furthermore, innovation in the field of CCIs has received particular attention from scientific researchers (Gohoungodji, 2025), highlighting their distinctive features and typologies covering aesthetic, symbolic, economic, and relational aspects (Gohoungodji and Amara, 2023).

As part of their national strategies of soft power and cultural influence, several countries around the world have invested in this field of cultural and creative industries, giving them great importance as key sectors and catalysts of their influence and cultural diplomacy, such as the United States, France, the United Kingdom, South Korea and Japan.

4. The CCIs Sector in Morocco: Growing Interest and Partnerships Serving Morocco's Cultural Diplomacy

Morocco places great importance on culture and its cultural and creative industries (CCIs) as strategic levers for inclusion, cohesion, economic prosperity, innovation, influence, and geopolitical soft power. The ambition of its New Development Model is to create the conditions for Morocco to capitalize on all its assets, including its rich and diverse cultural potential, by becoming a nation of opportunity, entrepreneurship, and innovation (SCDM, 2021). By contributing around 1% to Morocco's GDP with an ambition to reach 2 to 3% of the national GDP by

2030, and the creation of more than 100,000 jobs, the CCIs are positioned as strategic sectors with strong growth potential.

Indeed, The Moroccan New Development Model emphasizes the fostering of the growth of innovative cultural initiatives through the professionalization of cultural sectors, better access to public funding, public procurement, and international funds, and enhanced support (SCDM, 2021). It also calls for promoting and boosting innovative and high-quality cultural and media production contributing to debate, awareness-raising and the international influence of Morocco, through the establishment, among other things, of a digital platform for cultural industries focused in particular on the production of innovative and high-quality audiovisual content with an Afro-Mediterranean focus, in collaboration with national cinematographic and television structures (SCDM, 2021).

The Moroccan CCIs are characterized by a creative effervescence and a growing dynamic aimed at promoting Moroccan cultural diplomacy and creativity. This growing interest was marked by the creation in 2017 of the Moroccan Federation of Cultural and Creative Industries (FCCI), which identified, as shown in the figure below, eight key CCIs in Morocco:

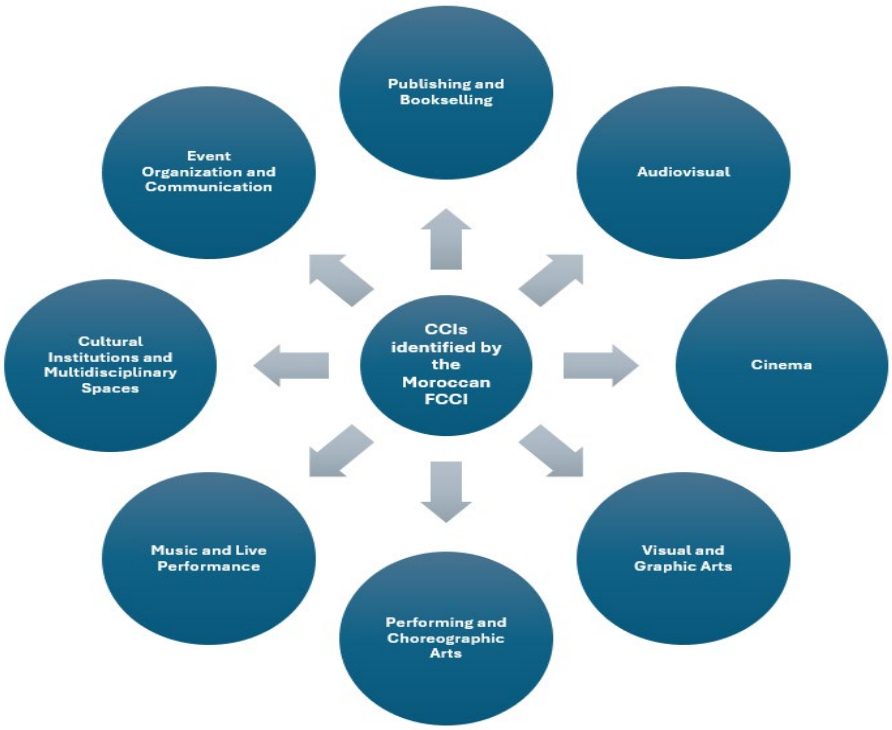


Figure 2: The Eight Key CCIs identified by the FCCI in Morocco

In addition, Morocco has initiated several cultural initiatives and events focused on its CCIs, using a collaborative approach that integrates public operators, the private sector, civil society, and international organizations involved in Morocco's various cultural and creative entrepreneurial ecosystems stimulating innovative entrepreneurship in these sectors. Morocco thus organizes several forums, exhibitions, festivals, conferences, and international meetings annually in conjunction with these CCIs. In this context, the organization of the first edition of the CCI Summit in 2019 and the second edition in 2024 demonstrates the strategic importance of these sectors, as affirmed by the organizers of these two events, namely the Ministry of Youth, Culture, and Communication, in collaboration with the Federation of Cultural and Creative Industries of the General Confederation of Moroccan Enterprises, and with the support of the European Union in Morocco, marked by the signing of several cultural cooperation agreements also focusing on the development of Moroccan CCIs.

All this testifies to the strategic importance and this dynamic partnership and repositioning of this Moroccan creative and cultural entrepreneurial ecosystem. It should also be noted that innovation was a major focus of the 2024 Conference, considered a pillar of the transformation of the CCIS, in addition to other themes also addressed, such as public-private partnerships, innovative financing, cultural tourism and heritage promotion, the impact of artificial intelligence and digital technology on human capital, and the global development prospects of the CCIS.

Thus, our research highlighted the fundamental role of Moroccan CCIs on the global cultural diplomacy scene in terms of promoting and projecting Morocco's cultural image, creating exportable cultural content, in addition to the cultural and tourist appeal they can generate through the various cultural events such as festivals and the various cultural participations abroad involving several Moroccan CCIs celebrating innovation and collaboration, such as the participation of Morocco as the Guest of Honor at the Paris Book Festival 2025, and the "Year of Culture Qatar-Morocco 2024", organized within the framework of the "Years of Culture Qatar" initiative.

5. Challenges and Constraints Limiting the Innovation Potential of CCIs and Their Contribution to Morocco's Cultural Diplomacy

What are the challenges facing the entrepreneurial ecosystems of the Cultural and Creative Industries, hampering their full innovation potential in the service of cultural diplomacy and Morocco's soft power? This is also the question we addressed in our research to identify the major challenges inhibiting innovation and reducing the ability of CCIs to move up a gear and achieve the expected impact and benefits of this strategic and highly promising sector.



Figure 3: The Main Challenges facing Moroccan CCIs

As shown in the figure above, among the major challenges unanimously highlighted by our interviewed population, insufficient and inadequate funding remains the weak point limiting the creative and innovative potential of CCIs. This challenge was also highlighted by speakers at the 2nd Conference on CCIs, held from December 4 to 8, 2024, in Rabat. Indeed, innovative startups and cultural entrepreneurs still face enormous difficulties accessing funding dedicated to cultural innovation and financial resources that match their ambitions. This obviously significantly hinders and limits their capacity for innovation, their risk-taking in cultural and creative projects and initiatives, and consequently impacts their international visibility. In this context, it should be noted that several countries such as the United Kingdom, Canada, France and South Korea have overcome this challenge by launching innovative and ambitious programs for financing and promoting cultural innovation in public-private partnership mode.

The second most frequently cited challenge concerns the governance of Moroccan creative and cultural entrepreneurial ecosystems, which are marked by a multiplicity of actors, a lack of interministerial coordination, and the absence of a unified and integrated vision uniting all stakeholders in these cultural and creative industries. As for the third challenge, it is the lack of sufficient and highly qualified human skills in these creative and cultural fields, which can accompany and support the development of these sectors in the era of artificial

intelligence and disruptive, emerging and especially immersive technologies, in particular those relating to virtual reality (VR), augmented reality (AR), mixed reality (MR), holograms, the metaverse, digital twins and many other innovative technologies which are invading the global cultural and creative field more than ever.

The fourth challenge is related to the infrastructure and technological deficits for cultural and creative innovation, marked in particular by limited access to immersive technologies and a concentration of infrastructure in major Moroccan cities. Other challenges impacting the CCIs ecosystems and limiting their innovation potential have been highlighted. These include the obsolescence and inadequacy of the legal and regulatory framework, which is unfavourable to innovation and does not meet the specific and urgent needs of these industries (intellectual property, CCIs taxation, status of artists, informality, etc.). In addition, other obstacles to innovation in these creative and cultural sectors were highlighted, such as the low capacity in cultural R&D, the weak entrepreneurial structuring of these cultural and creative industries, the reliable international presence and visibility of CCIs on an international scale, the low digitalization of the sector and the weak presence on global platforms.

6. Strategic Levers of Development to Increase the Innovative Potential of CCIs for Strengthening Moroccan Cultural Diplomacy

Based on the initiatives highlighted and the challenges already addressed by our research, it appears relevant to propose a conceptual model focused on innovation as a driving force of CCIs which consequently strengthens cultural diplomacy and drives a new cultural diplomatic dynamic and ultimately impacts Moroccan soft power and influence in a dynamic, cyclical and continuous interaction.

Thus, our conceptual model, as shown below, is designed as a structuring abstraction of our reflection and analysis. It demonstrates the ultimate goal, namely soft power embodied by a strong Moroccan brand image and a radiant positioning supported by effective, modern cultural diplomacy based on multidimensional innovation.

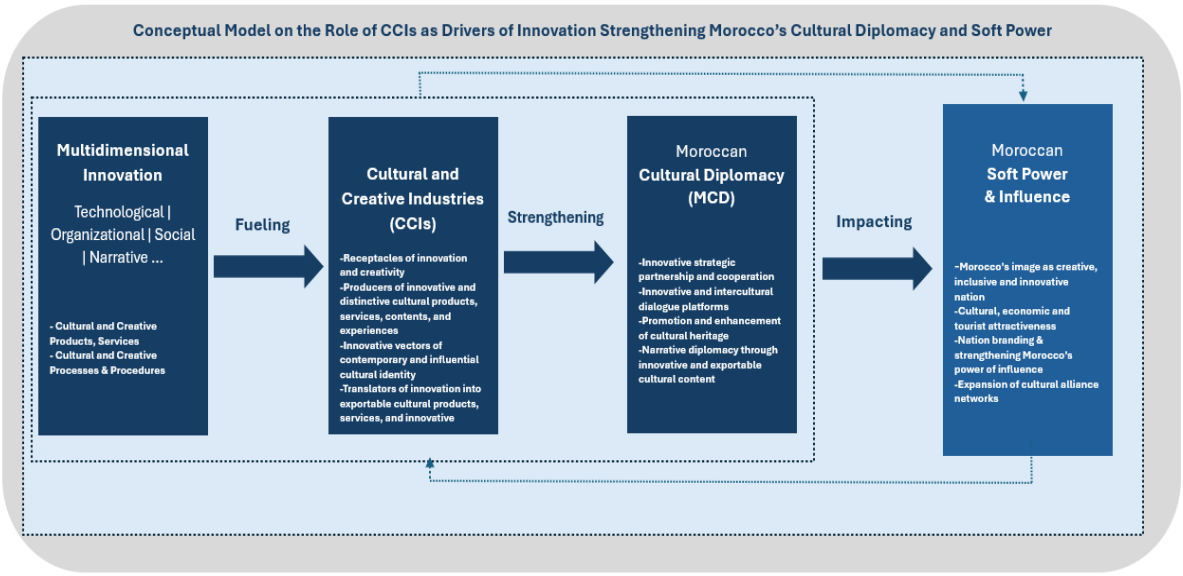


Figure 4: Conceptual Model on the Role of CCIs as Drivers of Innovation for Strengthening Morocco's Cultural Diplomacy and Soft Power

Thus, to achieve these objectives, and also based on our benchmarking of international best practices, particularly those of the United Kingdom, France, Germany, China and South Korea, we have identified the following strategic axes, with the common thread of innovation permeating the entire cultural field and all Moroccan creative and cultural industries and sectors:



Figure 5: Strategic Levers to increase Innovative Potential of Moroccan CCIs

6.1 New Agile and Innovative Governance

Among the recommendations most frequently mentioned by our survey population, agile and synergistic innovative governance ranks first. This demonstrates the critical importance of governance in its various innovative, ethical, and procedural dimensions of coordination, monitoring, control, and evaluation. We believe that good governance of all Moroccan cultural and creative entrepreneurial ecosystems requires, above all, a renewed and innovative strategic vision within the framework of a holistic approach that unites all sectors and all stakeholders without exception (public actors, private actors, civil society actors, academic actors, actors of high and popular culture, representation of all artistic sensibilities and regions, etc.).

New mechanisms and tools for coordination, collaboration, consultation, and communication should be designed and inspired by the pioneering British, Canadian and South Korean experiences. This should be implemented within the framework of a new public-private structure to strategically steer the integrated national strategy for innovative CCIs and ensure that they effectively contribute to strengthening Morocco's cultural diplomacy and soft power.

6.2 A Legislative and Regulatory Framework That Encourages and Supports the Innovative Dynamics of the Moroccan CCIs

The legal and regulatory arsenal is a second lever to be taken very seriously to be in tune with international standards and support the dynamics of Moroccan cultural and creative innovation. Indeed, at this level, it is necessary to put in place legislation that encourages and promotes the act of creating, innovating, investing, getting involved in the CCIs, producing cultural goods and services that promote Moroccan cultural heritage and can be easily exported internationally.

At this level, we recommend updating and modernizing the legal corpus to promote innovative CCIs and support their development so that Moroccan entrepreneurial, cultural and creative ecosystems can resolve all the issues hindering their development and limiting their innovative and creative potential. To this end, it is necessary to directly and effectively address the issues of intellectual property and copyright, the various administrative and bureaucratic constraints of investment, financing, taxation, incentive measures for the export of Moroccan cultural products and services, support for artists and cultural creators, and small and medium-sized Moroccan cultural enterprises. It is also necessary to ensure the supervision and institutionalization of new innovative cultural practices such as crowdfunding, and the various alternative and innovative means and tools for financing

cultural start-ups (public-private partnerships in the creative and cultural fields, crowdfunding, cultural patronage, innovative and specialized investment funds, venture capital, business angels, etc.).

6.3 Digital Innovation in CCIs to Successfully Undertake Their Internal Digital Transformation and Promote Their International Exportability

For CCIs to maximize their growth potential and their role in strengthening Moroccan cultural diplomacy, a major effort should be made to ensure the digital transformation of the Moroccan CCI sector. Indeed, under the combined impact of technological developments and global cultural dynamics, the digitalization of CCIs is no longer a choice, but an absolute necessity to increase the effectiveness and efficiency of Moroccan cultural and creative entrepreneurial ecosystems. Therefore, we recommend integrating CCIs into the programs and projects planned in the national strategy "Digital Morocco 2030," considering the creation of applications and platforms based on artificial intelligence and other emerging and creative technologies such as immersive technologies (virtual reality, augmented reality, mixed reality, cultural holograms, cultural digital twins, etc.).

Digital innovation can also take several forms, such as the creation of innovative digital streaming platforms and virtual tours of Moroccan museums, as well as the country's various monuments and cultural resources. It can also involve imagining new ways and methods of creating, innovating, producing, and disseminating Moroccan cultural goods and services abroad, thereby increasing the visibility of CCIs and strengthening Morocco's cultural cooperation relations with countries around the world. It is very beneficial for cultural entrepreneurs, artists, creators, startups, cultural SMEs and the various actors of the Moroccan CCIS ecosystem to modernize, internationalize, connect to the global cultural market and to the various partnership initiatives and cultural exchanges with other countries, for greater influence, visibility and impact of the CCIS.

6.4 Financial Innovation and Massive and Diversified Investment in CCIs

Innovation in Moroccan cultural diplomacy is closely linked to innovation in CCIs, which themselves remain correlated with creativity and innovation in the financial field to imagine new, innovative alternative financing methods that can solve the problems of scarce financial resources, such as Public Private Partnerships (PPPs), crowdfunding, and innovative collaborative projects to increase and diversify the funding sources of Moroccan CCIs. Indeed, it is necessary to have the means to match one's ambitions by creating innovative cultural funds to finance various Moroccan cultural programs, projects, and initiatives both in Morocco and abroad. While Morocco has created a Cultural Development Fund, which has financially supported several film and musical cultural projects, even professionals in the field believe it remains limited and deserves to be expanded to other creative and cultural sectors to support Morocco's cultural diplomatic momentum on the global stage.

6.5 Creative and Innovative Talent and Capacity Building for Cultural Stakeholders and Entrepreneurs

The Moroccan cultural and creative entrepreneurial ecosystems should have a new generation of creative and innovative talents capable of meeting the current and future challenges of the CCIs and Moroccan cultural diplomacy in the era of new disruptive technologies and global cultural competition between countries. This is a necessary condition for the CCIs to have the desired impact and to serve as real transmission belts and strategic levers for Moroccan cultural diplomacy.

In addition, it is recommended to strengthen the capacities of Moroccan cultural stakeholders and entrepreneurs through initial and continuing training programs to increase their skills and align them with the country's strategic orientations in terms of global visibility, influence, and cultural influence. It should be emphasized in this context that innovation at this level inevitably involves the professionalization of human capital, the stimulation of its creative sense in addition to the internalization of Moroccan creative and innovative talents of the engaging vision of the Kingdom in terms of cultural diplomacy and soft power by promoting the tangible and intangible cultural heritage and the symbolic and cultural resources of Morocco.

6.6 Partnership Innovation and Creative and Cultural Cooperation

Moroccan cultural and creative industries ecosystems require an integrated and innovative strategy for partnership and cooperation at the national and international levels in the creative and cultural fields.

Indeed, the strengthening of cultural exchange programs and initiatives should be designed and implemented in a forward-looking and imaginative spirit of convergence and coordination between the various national and

international public, private, and associative stakeholders in the Moroccan CCI ecosystem, with the involvement of regions and municipalities in strengthening and developing cultural and creative industries.

In this context, it is strongly recommended to increase and especially diversify partnership and cooperation agreements, both bilateral and multilateral, in priority areas of common interest to further develop the capacities of Moroccan CCIs and promote their export and internationalization. At this level, it is essential to launch new innovative cultural initiatives (new collaborative platforms, new innovative products and services, new labels, festivals, cultural exhibitions, trade fairs, foundations, etc.).

7. Conclusion

This paper explored the strategic role that cultural and creative industries can play as driving forces in strengthening Morocco's cultural diplomacy and soft power. It highlighted the centrality of innovation and creativity and their structuring and modernizing impact on Moroccan cultural and creative entrepreneurial ecosystems.

Our interviews with professionals, experts, and stakeholders in these cultural and creative fields showed that the most frequently repeated and underlying themes that permeate their discourse and emerge with high frequency in their narratives regarding innovation are, above all, the innovation mindset, creative and innovative DNA, growth drivers, transmission belts, led-innovation CCI, agile creativity, augmented and innovative Moroccan cultural diplomacy and soft power.

For the Moroccan cultural diplomatic machine to be innovative, the cultural and creative industries (CCIs) should be truly powerful and innovative transmission belts. Thus, by placing innovation at the heart of the CCIs, Morocco is directing its potential towards performance and inserting its cultural and creative entrepreneurial environment into an internationalization approach, global cultural influence combining agility, innovation and creativity and based above all on symbolic narrative storytelling, emotion and multidimensional innovation.

The results of our research also allowed us to identify levers of development within the framework of a conceptual model as a strategic framework for action for an optimal, effective and integrated integration of innovative CCIs in Moroccan cultural diplomacy.

Furthermore, this research has also opened new research perspectives concerning in particular the evaluation of the effectiveness and efficiency of the different initiatives and approaches of cultural and creative ecosystems for the strengthening of Moroccan cultural diplomacy, in addition to the impact of new emerging, immersive and disruptive technologies such as artificial intelligence, virtual reality, augmented reality, mixed reality, metaverse and blockchain, on cultural diplomacy, nation branding and soft power of Morocco.

Ethics Statement

This paper complies with ethical principles. No formal ethics approval was required, and all interviews were conducted with informed consent and fully anonymity.

AI Statement

The content of this paper and also all analyses, writing and conclusions are the original creation of the authors without the use of any AI tool.

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Understanding Organizational Stress in the Era of Digital Transformation

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Abstract: Organizational culture plays a key role in shaping occupational stress levels among employees, influencing the way they perceive, experience and approach workplace challenges. Researchers have paid significant attention to the impact of organizational culture on occupational stress, highlighting its role in well-being, professional performance and resilience among employees. Organizations are increasingly facing a fundamental change in their structures, communication processes and work environments as digital transformation accelerates. This paper contains a literature review on how organizational culture influences levels of occupational stress, with a particular focus on the challenges and opportunities it generates. This review provides insights into the evolving landscape of occupational well-being in the digital age by synthesizing the existing literature on organizational culture, workplace stress, and digital adaptation. In this regard, the findings highlight the need for proactive organizational culture transformations that balance technological advances with employee mental health and job satisfaction, ensuring that organizations can thrive in an era of rapid change. Initiatives regarding proactive cultural adaptation at the organizational level to balance technological advances with human resource management policies are increasingly necessary, and organizations that promote a resilient, inclusive and innovation-based culture can more easily adopt new digital tools, while reducing occupational stress and supporting employee engagement. This paper contributes to the wider discourse on digital adaptation and managing occupational stress, providing valuable insights for organizations seeking to optimize both employee performance and well-being in an increasingly digitized world.

Keywords: Occupational Stress; Digital Transformation; Organizational Culture; Employee Resilience; Change Management.

1. Methodology

This paper contains a systematic review of the specialized literature by reviewing relevant databases of articles published between 2013 and 2023. Focusing on addressing the phenomenon of occupational stress, especially in the context of DT adoption, was the main inclusion criterion. Moreover, a thematic analysis was conducted to identify common stressors, conceptual frameworks and strategies for its mitigation.

2. Unpacking the Essentials: Key Definitions

The first known theorist to use the term “stress” in the context of biomedicine was Hans Selye, who defined the concept and phenomenon of stress in a generic and non-specific way. The definition proposed by Selye, also called the “father of stress”, is: *“Stress is the non-specific response of the body to any demand”*. The term, as it emerges from Selye's understanding, is now used in all languages, including those that did not have such a term before (Fink, 2016, p. 12). Nevertheless, this first attempt to define stress is quite ambiguous and leaves room for interpretation.

In an attempt to trace the historical timeline of the development of concepts and processes associated with the phenomenon of stress, from the first concerns in this regard, historian Mark Jackson (2013) presents a detailed analysis of the definitions and dynamics of the concept of stress in modern psychology, starting from the formulation by the first researchers, Selye and Cannon, of the biological and adaptive theories of homeostasis, to a societal focus on understanding the effects of prolonged emotional stimulation or threat. In this regard, characteristics of the historical context - interwar and postwar - are highlighted by addressing issues such as military shocks, traumas and industrial fatigue.

Using a chronological approach, various authors have addressed the following question: assuming that stress is a universal mechanism, which exists over time and in different cultures, how do stress levels vary across time and cultures? The answers to this question are oriented around two general directions regarding the theories formulated - those that focus on processes based on the acceleration and flexibility of modern societies and those that emphasize the uncontrollable hardships and risks existing in the pre-industrial era. The first theory claims that the stress level is accentuated by modern life, while the second theory states that life was considerably more difficult in pre-modern societies. However, it can be considered that stress is a universal phenomenon, given that the physiological and endocrinological mechanisms that underlie it are the same regardless of time or culture. On the other hand, there is also the theory that stress is not universal, because the

social practices that contain these physiological and endocrinological mechanisms are no longer the same and even being stressed has become a way of existing in society (Hutmacher, 2021).

In the common understanding, the term "stress" generally has negative connotations, its negative effects being already known and assumed. Among the definitions supporting this idea are the following:

- "Any effect of change in surrounding environment on living being which results in disruption of homeostasis (internal balance) of that living being is called stress" (Shahsavarani et al., 2013, p. 5);
- "a state of mental or emotional strain due to adverse or demanding life circumstances" (Newbegin, 2014, p. 36);
- ""Stress" means feeling troubled or threatened by life" (World Health Organization, 2020, p. 11).

In the specific case of occupational stress, theorists have also provided definitions that often include negative elements or connotations. Examples in this sense include the definition provided by Cooper and Marshall (2013), who consider that organizational stress refers to "negative environmental factors or stressors (e.g. work overload, role conflict/ambiguity, poor working conditions) associated with a particular job. In addition to the environmental precursors, inherent characteristics of the individual and his behaviours may also contribute to occupational illness health".

From another point of view, there are theories that emphasize the influence of professional stress on creativity, focusing on the positive effects that it can entail. The way in which employees relate to the challenges or threats generated by stressors can mediate the impact of professional stress on creativity. For example, in the situation where employees perceive occupational stress as a challenge, it is very likely that they will adopt more effective cognitive strategies (Wang, Jackson and Cai, 2016), focus on the positive aspects of difficult situations, adopt better coping styles, based on problem solving and mobilize their cognitive resources to better cope with stressful situations (Akinola et al., 2019). In this way, employees will maximize existing capacities and opportunities, cultivating creativity.

According to studies, it was found that the number of researches and concerns regarding occupational stress increased especially in the period 1956-2020 (Zhang et al., 2021). During the COVID-19 pandemic, occupational stress was considerably high, especially among medical personnel, for which it was necessary to implement specific rules to reduce stress, difficulty concentrating and, therefore, to improve overall performance at work (Maniaci et al., 2021). Mental health and the impact of occupational stress on the health and productivity of employees have started to become increasingly important topics, and researchers are paying more and more attention to this phenomenon. Therefore, the word "stress" has become an increasingly used keyword, followed by terms such as "workplace stress" and "occupational stress" (Deng et al., 2019).

3. Roots and Reactions: Causes and "Symptoms" of Stress

3.1 General Causes

Among the factors of stress at work are aspects related to: (a) support from colleagues; (b) job autonomy; (c) ambiguity of the role (Mucci et al., 2015).

a. **Support from colleagues:** There is generally a degree of empathy between colleagues, as employees understand the similar situations faced by their peers. Therefore, they may consider the support from colleagues to be of real help and, at the same time, experience a certain commitment to the team (Xie et al., 2015). Thus, a working environment based on cooperation will be shaped in order to develop new and innovative ideas through the sustained support of colleagues, which is less likely to happen in organizations characterized by competitive attitudes, tension and reduced communication between colleagues (Wolgast, & Fischer, 2017).
b. **Job autonomy:** The employee's proactivity can be influenced by factors such as flexibility, the perception of work as free, the reduction of procedures and rules (Giebels et al., 2016). Although this approach will facilitate the development of new and creative processes and products, it directly depends on the clarity and transparency of hierarchical links at the organizational level and on encouraging employees to express their opinions (Kim et al., 2018). According to studies, supporting autonomy at work has positive effects, leading to increased job satisfaction, proactivity, well-being, motivation and self-esteem of employees, cultivating innovation (Di Marco et al., 2018).
c. **Ambiguity of the role:** It refers to the degree of uncertainty perceived by an employee regarding their tasks and how they should be performed (Palomino, & Frezatti, 2016). Ambiguity regarding

organizational objectives, goals, and procedures can impact employees' understanding of their roles, professional responsibilities, and performance evaluation criteria. Therefore, role ambiguity can negatively affect employee performance and, ultimately, organizational performance (Rogalsky, Doherty, & Paradis, 2016).

3.2 Causes Related to Digital Transformation

The particular context of digital transformation should be differentiated from general workplace stress and technological stress, in the sense that the concrete way ICT tools are implemented at an organizational level can become an important generator of workplace stress. Also, another significant distinction is between stress as a result of the change generated by the new ICT paradigm and stress related to the process itself of improper implementation of digital changes in the organization (Makowska-Tłomak et al., 2023).

The skills and competences of some employees, previously essential, may become less relevant within the new work models based on ICT solutions, which can become a stress-generating factor as a result of the adoption of digital tools. Consequently, employees may face occupational stress, negative emotions, feelings of lack of control or influence in relation to emerging technological changes at the organizational level and, ultimately, even the fear of losing their job (Hobfoll et al., 2018).

In order to be able to effectively address each type of stress and especially implement strategies to mitigate the negative effects of occupational stress-generating factors, it is necessary for organizations to understand and be aware of the difference between stress as a result of digital transformation and other types of stress at the workplace (Meske, & Junglas, 2021). The implementation of new ICT solutions at a too fast pace or in an inappropriate way can lead to an increase in requirements or at least the employees' perception of them and also to an increase in the level of stress, even among employees with advanced digital skills (Schlachter et al., 2018). Makowska-Tłomak et al. (2023) called this type of stress, resulting from digital transformation, as perceived digital transformation stress (STD). The researchers also made a comparison with technostress, assuming that STD occurs not because of negative attitudes towards new technologies or a lack of ICT skills and competences, but as a result of several factors, including: 1) the implementation of digital solutions in an inappropriate way and changes in the workplace; 2) poor management of digital transformation projects; 3) increased digital demands and 4) uncertainty about the professional future due to the pervasive nature of change and the perceived threat of losing significant resources.

3.3 "Symptoms" of Stress

A certain frequency and intensity of professional stress can lead to the appearance of more or less obvious "symptoms". The study conducted by Segal et al. (n.d.) analyzed these manifestations and signals frequently encountered in situations of high occupational stress, such as: cognitive effects (memory problems, reduced concentration, impaired judgment, anxiety); physical symptoms (different types of pain, nausea, dizziness, frequent colds or flu - which leads to absenteeism); emotional symptoms (general unhappiness, irritability or anger, feeling overwhelmed, tendency towards loneliness and isolation); behavioral manifestations (changes in appetite and sleep, procrastination or neglect of responsibilities, addictions, nervous tics).

Furthermore, according to studies conducted by The American Institute of Stress (n.d.), employees' repeated reporting of headaches, excessive worries, feelings of guilt, nervousness and constant fatigue are signals by which stress can be identified. Depression, frustration, irritability and anger can also be amplified by high levels of occupational stress. In such situations, employees often feel overwhelmed, alone, worthless, give less importance to the physical appearance, have exaggerated reactions to minor reasons, become extremely defensive and have serious problems with memory and communication with those around them. Furthermore, managers interviewed in this research stated that stress results in reduced productivity and decreased work efficiency.

4. How Organizational Culture Influences Occupational Stress Levels?

4.1 The Role of Organizational Culture in Shaping Workplace Stress

Organizational culture refers to the set of values and messages transmitted and understood within an organization, to which all staff must adhere, as well as to the way in which employees carry out their activity and interact with each other and with other organizational structures (Kang, & Lee, 2021). Dung Pham Thi et al.

(2021) analyze the different elements of organizational culture, such as company objectives, management style, work environment, employee beliefs and motivations. Therefore, there are different typologies and models of corporate cultures, from well-structured and bureaucratic ones, to companies focused on collaboration and inclusion. The effects on employee motivation and performance differ depending on each type of organizational culture, but they tend to work harder and more efficiently when they feel that they resonate and integrate into the organizational environment, which becomes a crucial factor in the evolution of their performance. Regarding workplace stress, in addition to other factors such as the lack of incentives given to employees, organizational culture could have an important impact on it (Maswani, Syah, & Anindita, 2019).

Naraya (2017) claims that a successful organizational culture is one focused on common beliefs and widely spread among employees, supported by well-implemented structures and strategies. Also, understanding the necessity of rewarding employees who demonstrate good organizational values is an essential element. Studies have shown that happy employees are more engaged at work and therefore more productive, increasing overall company efficiency and performance (Reidhead, 2020).

Although modern organizations make efforts to remain profitable, sustainable and up-to-date with new market trends, the increasingly dynamic and constantly changing environment can hinder the achievement of these objectives (Inanlou, & Ahn, 2017). Therefore, in an unpredictable context, organizations need to identify the main factors that influence performance. Analyzing the relationship between corporate culture and professional satisfaction, a study pointed out that a strong organizational culture is essential for increasing efficiency (Maswani, Syah, & Anindita, 2019). Positive and robust cultures can support employee performance, while negative and toxic cultures can lead to demotivation and discouragement, especially in the case of high-potential employees (Nikpour, 2017). These aspects demonstrate the direct and active role of organizational culture in performance management.

4.2 The Impact of Digital Organizational Culture on Employee Stress

Digital transformation refers to the integration of digital tools into organizational life, from how the business operates to how the organization interacts with stakeholders. It also implies a change in mindset and corporate culture, according to which the organization needs to challenge the status quo, become more open to new digital experiences, and adapt accordingly (Wahdaniah et al., 2023).

Defining and implementing clear strategies in the digitalization context is a necessity for all organizations, regardless of their nature. In this sense, the cultivation of an open and receptive organizational culture in relation to the digital transformation, the involvement of management in the paradigm change process and also the digital literacy of employees is required (Chernyavskaya et al., 2021). Digital organizational culture is characterized by several key attributes, including a strong adoption of innovation, a collaborative mindset, the ability to quickly process large volumes of data and information, the competence to work in complex environments, and the willingness to take risks.

Considering the dynamic environment, organizations must keep up with the new work methods based on digital technologies, by adopting policies for restructuring and retraining employees. The ability of the organization to anticipate trends regarding technological evolution and to adapt efficiently and quickly to them becomes essential, organizational agility and flexibility in relation to new technologies representing a competitive advantage on the market (Carvalho et al., 2019). In order to promote a beneficial work environment, where employees feel safe and involved in the change process, organizations must focus on a culture focused on innovation and flexibility. One of the essential aspects of a smooth change and adaptation process is the creation of a favorable work environment and a sense of appreciation among employees (Miklosik et al., 2019).

5. Conclusion

In conclusion, there is an increased interest in research and understanding of how the changes occurring as a result of the adoption of digital transformation at the organizational level affect employees, especially in the context in which it has introduced new dimensions of occupational stress. This is, according to various studies, a complex phenomenon, influenced by several factors such as personal perceptions and beliefs, digital skills and organizational culture, all of which facilitate or make it more difficult for employees to adapt to the new paradigm.

The studies reviewed show that the impact of digital transformation is felt differently across different types of organizations, depending on certain factors that can significantly reduce the negative effects of digital stressors,

such as managerial support, workplace flexibility, and a culture of continuous learning. Also, organizational culture plays an essential role in shaping how employees deal with digital transformation. Therefore, a corporate vision based on promoting innovation, collaboration and resilience among employees enables them to adapt more effectively to digital change.

According to the studies, organizations should adopt a holistic approach to digital transformation, considering the mental health of employees and promoting a culture of continuous, inclusive and collaborative learning. By prioritizing well-being and cultivating a sense of belonging among employees, companies can create a more sustainable and productive work environment, despite the potential pressures of digitalization, in order to maximize productivity and organizational success.

It is crucial to make a clear distinction between general stress and stress generated by digital transformation, as the two concepts can often be easily confused. The summary table below aims to facilitate and clarify this distinction (elaborated by the author based on the specialized literature analyzed in the paper).

Comparison Between General Stress and DTS		
Aspect	General Stress	Digital Transformation Stress
Main causes	Workload, leadership issues, job insecurity	Digital skills gap, the ICT implementation process, automation
Effects/Impact	Burnout, anxiety, reduced job satisfaction	Change resistance, Technostress, the fear of losing the job

Despite the research interest in understanding organisational stress in the context of digital transformation, there are still some gaps such as:

- Lack of empirical studies examining long-term stress outcomes related to digital transformation;
- Limited approaches regarding the role of organizational culture in mitigating DTS;
- The lack or small number of researches on proactive stress management strategies within organizations, specially adapted for DT contexts.

Ethics Declaration

This paper represents a review of the literature and does not involve human participants, experiments, or the collection of personal data, which means that ethical approval was not required for this study. The research adheres to ethical principles of academic integrity, ensuring that all sources are cited and properly acknowledged. There are no known conflicts of interest related to this study.

AI Declaration

Artificial intelligence-based tools have been used in a limited way and only for formal qualitative purposes, grammar and spelling checking and formatting assistance. However, the final version of the manuscript was checked and revised by the author to ensure accuracy, integrity, and originality. No generative artificial intelligence tools were used to create or analyze the content of this work.

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Triad Within Triad: Can Experimental Film be Profitable?

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Abstract: The Seventh Art - as the cinema is dubbed - is not the last in the list of arts but the most recent form of art. A century old already, the film industry has witnessed the emergence of the youngest member of the film family: the experimental film. This paper reports some results of a research-in-progress: a larger research project that started with setting the research framework of successive triads – specifically, the triad of experimental film. This model explores the interplay between artistic innovation, creative use of technology, and efficient resource management in the context of experimental filmmaking. While the mainstream film industry is astonishingly profitable, the experimental film ("indie") does not share a similar enjoyable fate. The facts that many great filmmakers started their careers producing experimental movies (on one side) and that experimental films feature minimal resources and costs, would incline to hypothesize their profitability. On the other side, the common knowledge is that production of short movies (as experimental films) is a "waste of time, money and other resources". Based mostly on secondary research, this essay launches the discussion on the profitability of the experimental film, challenging the above common knowledge. Two cases (results of primary research) are presented as argument for supporting the lead idea of this paper: the experimental film can be a profitable venture. The parallel discussion of cases uncovers, among findings, key factors for reaching profitability. Besides inherent limitations that indicate the paths for future research, this study has notable implications related to the sustainability and viability of experimental film production. Overall, practical arguments are brought in favor of the entrepreneurial potential of experimental endeavors in the film industry.

Keywords: Triadic Models, Triple S Holistic Approach, Triad Within Triad, Technology-business-art of Film, Experimental Film Triad, Experimental Film Profitability.

1. Introduction

Film has evolved as a "child of science and art" (Canudo, 1919), simultaneously being a technique, an art, and an industry (Lyon-Caen et al., 1957). Within this industry, experimental film represents a distinctive subgenre, born out of the desire to explore the boundaries of artistic and technical expressiveness. According to the principles of the triple S approach, this article proposes a triadic model for technology-based arts (Technology-Business-Art), specifically applied to cinema (Technology – Entrepreneurship - Art of Film) and experimental film (Technology-Entrepreneurship-Experimental Film).

The film industry, one of the most complex forms of art and entertainment, is a unique combination of technology, business, and artistic expression. Although marginal compared to commercial cinema, experimental film plays a significant role in the evolution of cinematic language. This type of film is defined by its exploration of unconventional forms and techniques, often rejecting traditional narrative structure (Sitney, 1974). Despite its artistic value, experimental film has rarely been seen as a viable business opportunity. Through an analysis based on triadic models, this essay aims to answer the central question: Can experimental film be profitable?

Cinema, referred to as "the seventh art" (Canudo, 2014), is a constantly evolving field, with experimental film representing a young and innovative branch. While the mainstream industry demonstrates impressive profitability, experimental films are often perceived as unprofitable - even though many famous directors began their careers in this niche (Le Grice, 2002).

"Today's cinema is taking on a new face... That is why I speak of the avant-garde. There is always an avant-garde when something new occurs... That is why I would like to call this new era of cinema the age of the camera-pen", wrote Alexandre Astruc in his article The Birth of a New Avant-Garde: La Caméra-Stylo (Astruc, 1948).

This research explores the premises of experimental film profitability using the triadic Technology-Entrepreneurship-Art of Film model and the holistic triple S approach. Innovations such as digital cinematography allow directors to create immersive experiences using advanced visual effects (Bares and Lester, 1997). Experimental films can thus visually compete with mainstream productions, without the high costs associated with celluloid film.

The COVID-19 pandemic also catalyzed this shift, pushing film festivals into digital spaces and prompting creators to experiment with alternative methods of funding, production, and distribution. Independent film often uses innovative financing models such as crowdfunding to reduce dependence on traditional investors, direct-to-audience sales, and partnerships with streaming services have become increasingly viable avenues for financing experimental projects, helping filmmakers maintain creative control while reaching wider audiences (Levison, 2013). This enables directors to retain artistic control and build a loyal audience.

Recent years, however, have witnessed a transformation in how experimental films are created, distributed, and monetized. The democratization of digital filmmaking tools and the emergence of distribution platforms such as YouTube, Vimeo, and MUBI have allowed experimental filmmakers to reach global audiences without relying on traditional industry gatekeepers (Lobato, 2019; Tryon, 2013). This increased accessibility has not only expanded the visibility of experimental cinema but has also enabled the formation of loyal, niche audiences willing to support innovative content.

Contemporary filmmakers like Apichatpong Weerasethakul, Jennifer Reeder, and Sky Hopinka exemplify how experimental aesthetics can achieve both critical acclaim and sustained international presence. Emerging technologies - including artificial intelligence, augmented reality, and blockchain - further redefine the artistic and economic landscape of experimental film, opening new modes of expression and novel revenue streams. The concept of "expanded cinema" is being reimagined through immersive, multi-sensory formats that challenge the limitations of traditional screens (Smits, 2019, 2022).

Therefore, far from being merely a niche artistic endeavor, experimental film today serves as a dynamic space of innovation and creative entrepreneurship. This research proposes a reevaluation of its economic potential through the triadic Technology–Entrepreneurship–Art of Film model, arguing that profitability is not only possible but compatible with artistic integrity in the digital age.

2. Context and the Triadic Model

The triadic model of Technology – Entrepreneurship - Art of Film, as described by Scarlat and Zăvoianu, provides a conceptual foundation for investigating the interdependence between technology, artistic innovation, and the economic sustainability of film. This model emphasizes the interaction between technological innovation, entrepreneurial initiative, and artistic expression as pillars of success in this field (Zăvoianu and Scarlat, 2024). While the mainstream film industry is recognized for its profitability, experimental films are often perceived as occupying a marginal artistic territory with little economic potential, typically sustained by the enthusiasm of their creators. However, history shows that many renowned filmmakers - such as Tarantino, Jarmusch, and Scorsese—began their careers with experimental films, using them as a testing ground for their visions (Zăvoianu and Scarlat, 2024).

Furthermore, initiatives like the "Free Cinema" movement in England (Lindsay Anderson, Tony Richardson, Karel Reisz, and Lorenza Mazzetti, 1956) or "Dogma 95" in Denmark - a groundbreaking film production movement founded by directors Lars von Trier and Thomas Vinterberg, creators of the *Dogma 95 Manifesto* and the *Vow of Chastity* (*Kyskhedsløfter* in Danish) - have demonstrated that experimental films can be produced with extremely low budgets, using small crews and natural locations. These movements significantly influenced the development of independent film by promoting innovative and authentic ideas. Nevertheless, the hypothesis that experimental film can be profitable is examined from an entrepreneurial perspective.

This article explores the contradictions between the limited resources required to produce experimental films and the general perception of their low profitability, offering both theoretical and practical arguments for reconsidering their position within the industry. The film industry has evolved alongside technological development, becoming a global economic force. Experimental film, however, remains a niche subject, associated with artistic innovation but rarely with financial success. In this context, the fundamental question remains: *Can experimental film be profitable?*

This study employs a qualitative, exploratory research design grounded in conceptual analysis and the examination of selected case studies from the domain of experimental film. The primary objective is to investigate the interactions between technology, entrepreneurship, and artistic expression, as framed by the Triadic Model of Film (Technology - Entrepreneurship - Art), developed by Scarlat and Zăvoianu (2024).

Data collection was based on a comprehensive literature review, encompassing academic sources, manifestos from experimental film movements, and recent studies on film profitability. Predictive models used in mainstream cinema were also examined to assess their applicability to experimental film.

In order to substantiate the central hypothesis—that experimental film can become economically viable through the strategic integration of technological tools and entrepreneurial vision—the study identifies historical and contemporary examples of independent film movements, creative collectives, and grassroots initiatives that have achieved cultural or financial relevance. The findings are interpreted through an interdisciplinary lens at the intersection of creative economy, digital media, and cultural entrepreneurship.

This article applies the triadic model to experimental film, analyzing its economic potential through the lens of technological accessibility and entrepreneurial approaches. According to research, experimental film can be analyzed through two triads: (1) the general triad of cinematic art (Technology – Entrepreneurship - Art of film), and (2) the specific triad for experimental film (Technology – Entrepreneurship - Experimental Film).

The study explores the economic potential of experimental film using the Triadic Model of Technology - Entrepreneurship - Art of Film (Zăvoianu and Scarlat, 2024). This framework integrates:

1. *Technology* - digital tools and platforms reducing costs and fostering innovation;
2. *Entrepreneurship* - strategies like crowdfunding and niche marketing;
3. *Art of Film* - creative, experimental narratives diverging from mainstream cinema. The model views these as synergistic, not conflicting, elements driving cultural and economic impact. Supported by conceptual analysis, the research clarifies terms like “profitability” and “innovation,” positioning experimental film as both art and viable enterprise within media studies and creative industries.

This model highlights the interaction between technological innovation, entrepreneurial initiative, and artistic expression as pillars of success in the field. Moreover, a recent study analyzed the economic potential of films by developing a model capable of predicting their profitability based on various characteristics, including content, distribution, audience perception, and budget. This model could also be applied to experimental films to assess their commercial viability (Swami et al., 2021).

Additionally, involvement in experimental film communities and collectives, such as the Experimental Film Society, can provide opportunities for collaboration and distribution, contributing to the economic success of these productions.

In the paper *Analyzing Movies to Predict Their Commercial Viability for Producers* by Devendra Swami and collaborators, it is stated that “Although many high-budget films have achieved exceptional success, others have failed miserably. Therefore, it is essential to develop models that can predict a film’s profitability before release” (Swami et al., 2021). In the article *Box Office Collection of Sequel Movies: Exploring Brand Extension Effect* by Prem Prakash Dewani and collaborators, it is mentioned that “Collecting box office revenue data can provide valuable insights into the factors that influence a film’s commercial success” (Dewani et al., 2021). In *Experimental Film and the Development of Film Study in America*, Michael Zryd affirms: “Experimental film played a crucial role in the development of film studies in America, offering new perspectives on film theory and practice” (Zryd, 2008). Kathryn Ramey, in *Productive Dissonance and Sensuous Image-Making: Visual Anthropology and Experimental Film*, notes: “Experimental film and visual anthropology share a productive dissonance that stimulates the creation of sensorial imagery and new ways of understanding culture” (Ramey, 2011). In *Experimental Ethnography: The Work of Film in the Age of Video*, Catherine Russell observes: “Experimental ethnography employs innovative filming techniques to explore the complexity of cultural representation in the video age” (Russell, 1999).

Therefore, integrating technology and entrepreneurship into experimental film production can open new opportunities for the economic success of this genre, transforming it from an artistic niche into a viable component of the film industry.

2.1 The General Triad of Cinematic Art: Technology–Entrepreneurship–Art of Film

The triadic model of technology-based art—*Technology–Entrepreneurship–Art of Film*—provides an essential framework for understanding the complexity and interactions within cinema, particularly in the context of experimental film.

This perspective integrates the technological, economic, and artistic dimensions, illustrating how each contributes to the evolution of cinema.

- Technological advancements are central to cinema's development, enabling novel artistic expressions while lowering production costs. Affordable digital cameras, advanced editing

software, and computer-generated imagery (CGI) have democratized access to creative tools, allowing filmmakers to experiment beyond previous financial constraints. Experimental cinema particularly benefits, using technology to explore unconventional narrative and visual forms. Innovations such as digital cinematography and CGI have reduced entry barriers, empowering independent creators to realize their visions (Whissel, 2014).

- Economic considerations remain integral, even in experimental cinema. Financing, production, and distribution demand strategic approaches to sustain projects. Platforms like film festivals, streaming services, and digital sales monetize experimental works, ensuring investment recovery while broadening artistic reach. Entrepreneurship has become vital, as filmmakers evolve into "*filmtrepreneurs*" (Ferrari, 2019), blending creativity with innovative economic strategies.
- Art lies at the heart of this triadic model, defining and distinguishing cinematic projects. As P. Adams Sitney asserts, experimental cinema arises from aesthetic, not commercial or technological, impulses, placing artistic innovation at its core. Iconic works by Maya Deren (e.g., Meshes of the Afternoon) and Stan Brakhage (Dog Star Man) exemplify art-driven cinema, emphasizing form, perception, and rhythm over financial or technological motives (Sitney, 2002). Experimental films inherently transcend genre boundaries, exploring new forms of expression that challenge and inspire audiences. While reliant on technology and economics for public access, their creative impetus lies in artistic exploration, often yielding impacts disproportionate to their resources.

Art's primacy in this triad is evident as technology and economics adapt to evolving artistic needs. As Manovich notes, digital tools are reshaped by artists to enable innovative storytelling (Manovich, 2002). This synergy underscores how artistic vision drives technological and economic strategies.

The relationship between *Technology, Entrepreneurship, and Art of Film* is symbiotic, with each component fueling and supporting the others. The triadic model offers a unique perspective on cinema, emphasizing the importance of balance between technological innovation, economic sustainability, and artistic expression. Especially in the case of experimental films, this interaction becomes the key to understanding and appreciating the role of technology-based art in the contemporary cultural landscape.

2.2 The Specific Triad of Experimental Film: Technology–Entrepreneurship–Experimental Film

The film industry has evolved dramatically over the decades, establishing itself as a global economic force through the integration of emerging technologies and innovative business approaches.

The mainstream film industry is traditionally structured around a triad comprising Technology, Capital, and Mass Audience Appeal. Technology facilitates large-scale production and visual spectacle, including innovations such as CGI, IMAX, and 3D. Capital, sourced from studios or investors, is driven by expectations of high financial returns. Mass Audience Appeal shapes content creation, often favoring tested formulas such as genres and franchises. This triad fosters a commercially oriented feedback loop in which significant investment supports advanced production technologies that enable the creation of visually spectacular products aimed at broad audiences, thereby maximizing revenue.

However, *experimental film*, a niche subject centered on artistic and narrative innovation, is often perceived as lacking financial viability.

This raises the relevance of the triad: *Technology–Entrepreneurship–Art of Film*, as illustrated in *Figure 1*. The analysis is conducted at a conceptual level, by examining each pair of components, followed by a discussion on a potential integrated study. The *Technology–Entrepreneurship* relationship has already been discussed (Scarlat, 2014), while the following sections on *Technology–Art of Film* and *Entrepreneurship–Art of Film* were explored in the study *Complexity of Triadic Models: The Triad Technology–Entrepreneurship–Art of Film* (Zăvoianu and Scarlat, 2024).

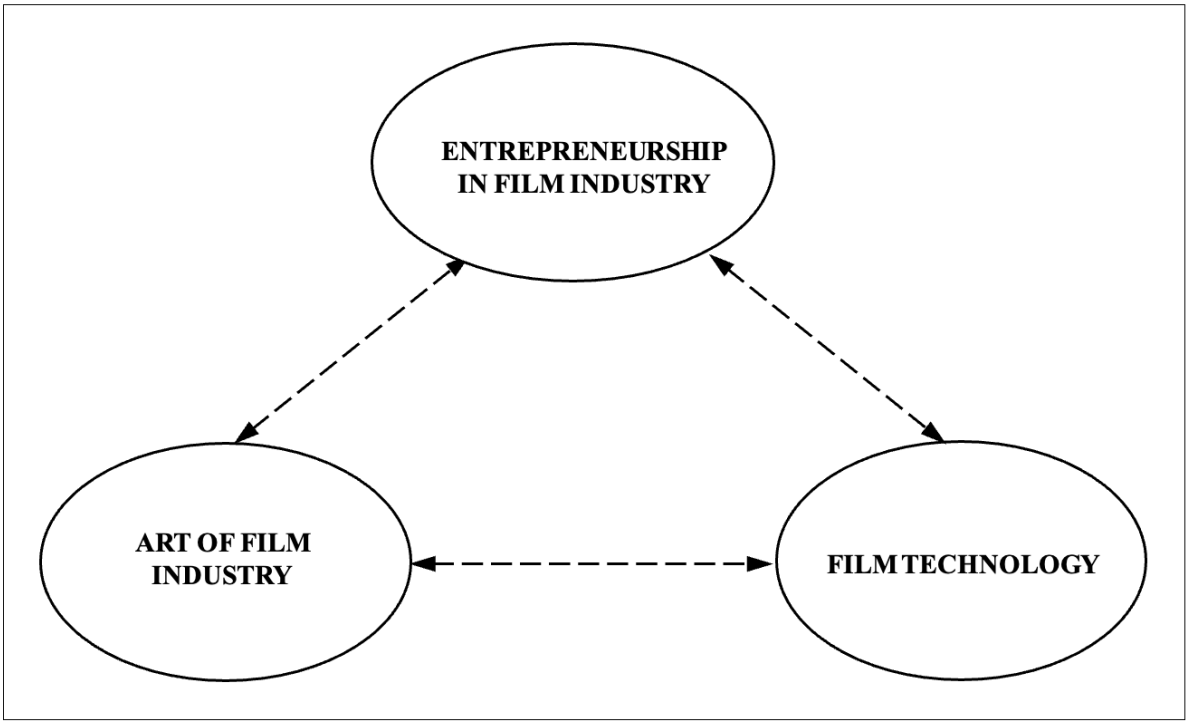


Figure 1: A particular model of the technopreneurship triad - *Technology-Entrepreneurship-Filmmaking* - in the case of film industry

Source: Authors' own contribution to the research

In this context, it becomes essential to investigate whether experimental film can become profitable by using the triadic model composed of *Technology, Entrepreneurship, and Experimental Film*. This model offers an analytical perspective for understanding the relationship between creativity and economic sustainability.

Technological progress has transformed the film industry by drastically reducing costs and democratizing access to production tools. In the past, producing experimental films was limited by the high cost of equipment and technical resources. Today, independent filmmakers can create high-quality productions using affordable digital cameras, advanced editing software, and online distribution platforms. Digital technologies allow creators to experiment with new visual and narrative aesthetics without relying on large budgets. For example, the use of AI-generated animation techniques or motion capture can add artistic value to experimental productions.

The financial success of experimental film depends on adopting an entrepreneurial mindset. Directors must identify alternative sources of funding, such as crowdfunding, which enables them to raise money directly from the public. Notable examples include platforms like Kickstarter and Indiegogo, which have supported numerous independent projects. Distribution also plays a crucial role. Experimental films can bypass the traditional cinema network by opting for digital platforms such as YouTube, Vimeo, or online film festivals. Additionally, digital marketing—through the use of social media, viral campaigns, and partnerships with influencers—enables directors to reach niche audiences in a cost-effective way. A historically relevant example is United Artists, which supported independent productions through an innovative economic model.

Experimental film distinguishes itself by rejecting conventional narrative structures and exploring visual aesthetics. Although this genre appeals to a limited audience, its innovative character has the potential to attract attention at prestigious festivals such as Sundance or Tribeca. International recognition offers not only artistic prestige but also monetization opportunities, such as the sale of rights to streaming platforms or international releases. The success of this genre depends on creating an authentic and compelling product that resonates with audiences beyond the traditional visual experience. Experimental films, like those of Stan Brakhage or Maya Deren, have demonstrated that narrative and visual innovation can generate significant cultural impact, attracting a loyal audience segment.

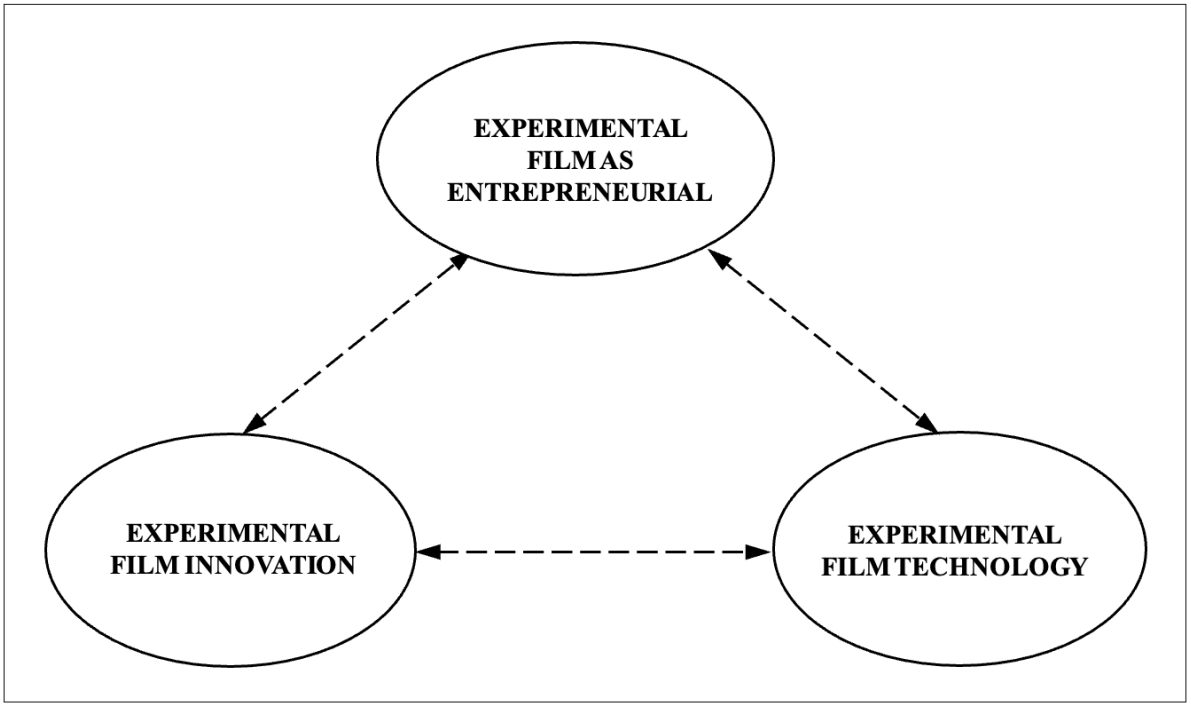


Figure 2: The triad of the experimental film as a particular case of the triad of the mainstream film: *"triad within triad"*

Source: Authors' own contribution to the research

The triadic model *Technology, Entrepreneurship, and Experimental Film* highlights the synergy between these essential components. Reducing production costs through technology, adopting entrepreneurial strategies for funding and distribution, and emphasizing artistic uniqueness are fundamental steps toward transforming experimental film into a profitable product. This model not only analyzes financial challenges but also offers practical solutions, demonstrating that the economic viability of experimental film is achievable, especially in the context of the digital revolution.

Mainstream film prioritizes profit through accessibility, standardized storytelling, and mass appeal, while experimental film emphasizes artistic innovation, niche audiences, and creative entrepreneurship. Both leverage technology differently: mainstream for scaling, experimental for cost reduction and individual creativity. The models contrast in goals but intersect as experimental film adopts entrepreneurial strategies while retaining its artistic essence.

While experimental film is often seen as an artistic niche, it holds the potential to become financially sustainable through the application of the triadic model. Technology lowers production costs, entrepreneurship facilitates access to resources, and artistic uniqueness attracts a loyal audience.

2.3 The Profitability of Experimental Film in the Context of the Triple S Approach

Often perceived as a purely artistic domain and difficult to monetize, experimental film nonetheless offers significant economic opportunities. Through the lens of the Triple S approach (Synthetic, Systemic, Synergic) (Scarlat, 2021), this form of artistic expression reveals its potential to become a sustainable business model.

2.4 Experimental Film as a Business Model

Experimental film stands at the intersection of technology, entrepreneurship, and artistic innovation.
In the context of experimental filmmaking, the triad evolves into a specific model: *Technology – Entrepreneurship – Experimental Film*.

The Triple S approach frames experimental film as a dynamic facet of the creative economy, blending technology, artistry, and entrepreneurship into a unified model. Digital tools democratize production, allowing filmmakers to innovate while minimizing costs. Simultaneously, directors act as cultural entrepreneurs, securing funding through grants, crowdfunding, and patronage. Systemically, experimental film exists within an

ecosystem of festivals, streaming platforms, art galleries, and niche cinemas, supported by policies, grants, and educational programs that enhance its viability and profitability.

The synergic dimension underscores the value of collaboration, where partnerships between artists, technologists, and institutions amplify creative and financial outcomes. Online communities, transmedia storytelling, and hybrid events expand audience engagement, fostering deeper connections and new revenue streams. This synergy transforms experimental film into a collaborative, sustainable enterprise. Through its synthetic, systemic, and synergic dimensions, the Triple S framework highlights how experimental film not only survives but thrives within the contemporary creative economy.

Table 1: Comparative case study for the films Primer and Tarnation

Case Studies	Primer (2004) Cinematic Experiment and Profitability	Tarnation (2003) Personal Story, Global Impact
Details about the Film and Production	**"Primer"** is a science fiction film directed by ***Shane Carruth***, who also wrote the screenplay, produced, directed, and edited the film, as well as starred as one of the main characters. Made on a minimal budget of just **$7,000**, the film focuses on the accidental discovery of a primitive form of time travel by two engineers. Its dense storyline and complex narrative structure have earned it a reputation as a cult classic.	**"Tarnation"**, directed by ***Jonathan Caouette***, is an experimental documentary that explores the director's life and his complicated relationship with his mother, who suffered from severe mental illness. Created on an incredibly small budget of just **$218**, the film was edited using iMovie, an accessible editing software. The filmmaker used personal video footage, including VHS recordings and photographs.
Key Strategies for Success	1. Low production costs: - Filming took place in real and affordable locations, such as garages or friends' homes. - Shane Carruth, with a background in engineering, designed and built many of the devices featured in the film, significantly reducing expenses. 2. The film was screened at the ***Sundance Film Festival***, where it won the Grand Jury Prize. This award brought visibility and attracted the attention of distributors. 3. ***"Primer"*** was acquired by THINKFilm for distribution, being released in theaters and later on DVD. 4. Total earnings exceeded ***$500,000***, demonstrating that a minimal budget can generate significant profits when creativity is at the forefront.	1. Authentic and personal story – the film is deeply emotional and genuine, capturing the attention of audiences and critics with its honest and innovative approach. 2. ***"Tarnation"*** premiered at the ***Sundance Film Festival***, where it received critical acclaim and caught the attention of distributors. It was also featured at the ***Cannes Film Festival***, where it continued to gain international recognition. 3. The film was acquired by Wellspring Media for distribution. 4. Total earnings exceeded ***$1 million***, a remarkable achievement considering the extremely low budget.
Impact and Influence	***"Primer"*** remains an iconic example of independent filmmaking, praised for its scientific realism and challenging narrative approach. The film proved that success doesn't always rely on big budgets, but rather on innovative ideas and creative execution.	***"Tarnation"*** changed perceptions of what an experimental film can be. It is considered a milestone in using accessible technology to create compelling stories and stands as a successful example of blending personal narrative with technological innovation.

Source: Authors' own contribution to the research

In a film landscape dominated by mainstream productions with exorbitant budgets and aggressive marketing campaigns, experimental films may initially seem like an artistic niche with little economic potential. However, the application of the Triple S approach (Systemic, Synthetic, Synergic) shows that these productions can be profitable, sustainable, and culturally relevant. By exploring accessible technology, creative entrepreneurship, and alternative distribution, experimental films not only survive—they thrive.

The examples of *"Primer"* (2004) and *"Tarnation"* (2003) illustrate this reality, demonstrating that success in experimental cinema is rooted in innovation and adaptability.

The Triple S model applies to experimental film through three essential components:

- *Technology* – The democratization of digital technologies enables film production with limited resources. Smartphones, DSLR cameras, and editing software like iMovie provide unprecedented accessibility. In the case of *"Tarnation",* Jonathan Caouette used iMovie to edit a deeply personal documentary, spending only $218. This accessible technology transformed an intimate story into an internationally recognized artistic product.
- *Entrepreneurship* – Experimental filmmaking often requires creators to take on multiple roles—directors become producers, editors, and even marketing specialists. Shane Carruth, the creator of *"Primer,"* used his engineering knowledge to cut production costs by designing the film's props. Moreover, both films gained visibility through festivals like Sundance, where artistic recognition led to commercial distribution.
- *Experimental Film* – The innovative nature of experimental film attracts a niche audience through festivals and online platforms. Unlike traditional films, these productions don't compete on commercial grounds but offer a unique artistic experience. Both *"Primer"* and *"Tarnation"* were praised for their distinctive approaches, becoming cultural landmarks in independent cinema.

By adopting the Triple S approach, experimental film can overcome traditional financial barriers. The analyzed case studies show that technological democratization and alternative funding models are key elements of success.

Although challenges remain significant, the cultural value and economic potential of experimental cinema confirm its sustainability in the contemporary landscape.

3. Conclusions and Perspectives

The triadic model Technology–Entrepreneurship–Experimental Film demonstrates that experimental cinema can be profitable when approached with an entrepreneurial vision.

Although experimental films are not as profitable as mainstream productions, they offer unique opportunities for entrepreneurship and artistic innovation. By adapting distribution and marketing strategies and tapping into new markets, experimental cinema can become a profitable niche, sustained by creators' passion and the growing public interest in authentic and unconventional art forms.

Digital platforms and accessible technologies represent key opportunities, and the cultural value of these productions justifies their support.

This work paves the way for future research into the integration of triadic elements and the development of sustainable strategies for experimental filmmakers.

Despite common perceptions, experimental film can be profitable when approached with an entrepreneurial mindset. Leveraging accessible technology and digital platforms, along with artistic innovation, can transform experimental films from niche products into economic opportunities.

The triadic model *Technology–Entrepreneurship–Experimental Film* offers a new perspective on this subgenre, demonstrating that financial success and artistic expression are not incompatible concepts.

While financial challenges remain significant, experimental film is not a lost cause. By exploiting the triad of *Technology–Entrepreneurship–Experimental Film*, directors can turn these projects into sustainable initiatives. With proper funding and distribution strategies, experimental cinema can overcome the stereotype of unprofitability and become a profitable part of the global film industry.

The profitability of experimental cinema does not lie in replicating the mainstream model, but in harnessing alternative markets and its unique status within contemporary art. With a well-planned strategy, experimental films can not only generate revenue but also redefine the film industry both artistically and entrepreneurially. This niche, although modest, can become an example of a future where technology, art, and business converge.

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Non Academic Papers

From Research to Impact: Empowering Researchers Through the HAFIS Intrapreneurship Academy

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Abstract: This article presents the design, implementation, and preliminary outcomes of the Helmholtz Academy for Intrapreneurship (HAFIS), launched in 2023 with funding from the German Helmholtz Association. HAFIS addresses the persistent challenge of translating academic research into societal and economic impact by equipping researchers with entrepreneurial competencies and structured support for developing transfer-oriented projects. The nine-month programme combines milestone events, workshops, and individualised coaching to support participants from four Helmholtz centres in identifying, validating, and advancing research-based innovations. Structured around three key events—Kick Off, Mid Term, and Impact Day—HAFIS fosters interdisciplinary collaboration and enables researchers to apply entrepreneurial tools directly within their scientific practice. Guided by a human-centred, iterative design, the programme continuously evolves based on participant input to ensure contextual relevance and practical effectiveness. By June 2025, HAFIS had completed its second cycle, with a third beginning in September 2025. Initial findings suggest increased engagement, the emergence of early transfer initiatives, and shifts in institutional norms toward innovation-oriented research cultures. By embedding entrepreneurial thinking into research environments, HAFIS offers a transferable model for other institutions seeking to strengthen knowledge transfer and societal engagement within the academic sector.

Keywords: Academic Entrepreneurship, Intrapreneurship, Knowledge Transfer, Research Impact, Innovation Process

1. Introduction

Research and innovation are widely recognised as drivers of societal progress and global competitiveness. Research institutions—such as those within the Helmholtz Association—play a pivotal role in translating technological breakthroughs into practical applications (Kivimaa et al., 2017; Rasmussen & Wright, 2015). However, many research outcomes remain underutilised due to barriers such as limited entrepreneurial skills, insufficient understanding of market needs, and inadequate support structures (Hayter et al., 2018; Manthey et al., 2022). To address today's pressing global challenges, research institutions must adopt innovative strategies that accelerate the transfer of scientific knowledge into societal and economic impact.

In 2023, the Helmholtz Academy for Intrapreneurship (HAFIS) was founded as part of the Helmholtz Transfer Academies (HTA), with financial support from the Helmholtz Association of German Research Centres, one of the largest non-university research organisations in Germany. HAFIS aims to close the gap between research and practical application by fostering entrepreneurial thinking and action among researchers. To achieve this, it prioritises four central goals:

1. Empowering researchers to identify opportunities for own transfer projects that resonate with them personally, to advance them towards concrete ideas and implement them while maintaining or increasing research effectiveness.
2. Having participants achieve tangible results with their transfer projects to receive external appreciation and experience self-efficacy.
3. Strengthening the transfer culture in participating research organisations by promoting sustainable, problem-solving skills that lead to project success and, thus, are communicated.
4. Contributing to qualifying researchers for their future careers and highlight alternative career paths beyond research.

Unlike many existing academic entrepreneurship incubators which start with researchers who already have a startup-idea, HAFIS addresses a critical yet often overlooked gap: the early-stage translation between research and validated application. While it's encouraging that entrepreneurial support structures are becoming more common at research institutions, these initiatives frequently fail to resonate with researchers who have little to no background in economics or entrepreneurial thinking. The stages between a promising research result and a viable application are often underrepresented and rarely supported in a structured, researcher-centred way (Manthey & Terzidis, 2024). Moreover, researchers typically encounter entrepreneurship only indirectly—through supervisors, peers, or external events—making it unlikely for them to explore its relevance on their own.

To bridge this divide, HAFIS invites researchers to uncover the application potential within their own work and to develop ideas that could lead to real-world impact. This is facilitated through a structured, reflective process grounded in Action-Based Learning (Bell & Bell, 2020; Freeman et al., 2014). Rather than relying on theoretical instruction alone, HAFIS integrates entrepreneurial training into participants' ongoing research activities. This approach emphasises experiential engagement, real-time application, and structured reflection—making it highly suitable for navigating the uncertainties of early-stage transfer. Participants actively shape their own projects, receive tailored feedback, and iterate based on lived experience. This pedagogical model ensures that entrepreneurial thinking becomes embedded rather than superficial—enabling researchers not only to think differently but to act differently, transforming their research into viable solutions with real-world impact.

The results are tangible. Participants described HAFIS as "a space for growth beyond the lab" that enabled them to build networks and develop new capacities. Others valued the motivating atmosphere and practical support: "It connects you with the right sparring partners." A team summed up their experience by highlighting "collaboration, continuous learning, and adaptability" as essential ingredients for moving their research into application. These testimonials reflect a recurring theme: researchers gain not only practical tools but also a shift in mindset—toward agency, creativity, and the courage to transfer their ideas into societal and economic impact. For most participants, HAFIS is their first structured opportunity to seriously engage with entrepreneurship in a way that resonates with their identity as scientists.

Now entering its third cycle in September 2025, HAFIS evolves continuously through iterative, participant-informed processes. Its design integrates ongoing qualitative feedback and strategically timed surveys, allowing the programme to remain responsive to participants' evolving needs. This adaptive and pragmatic approach supports continuous refinement of the programme. By the end of its third and final funded cycle, HAFIS aims to become a validated, scalable model. The programme will be made available to other research institutions, enabling them to replicate and adapt the model for their own needs. In doing so, HAFIS contributes directly to the Helmholtz Association's mission of ensuring that publicly funded research leads to measurable, lasting societal benefit.

2. Theoretical Part

2.1 The Challenge of Research Transfer in Practice

Translating research into societal or economic impact is a widely acknowledged goal of modern science policy (Katzman & Azziz, 2021). Universities and research institutions typically engage in knowledge and technology transfer through mechanisms such as spin-offs, licensing, and industry collaborations. In recent years, additional formats such as policy advising and network-building have emerged as meaningful forms of societal engagement (Stifterverband, n.d.).

However, engaging in transfer activities requires a set of skills and resources that many researchers lack. Prior studies point to a lack of entrepreneurial training, time constraints, limited access to relevant networks, and unfamiliarity with tools for idea development and market exploration (Müller-Wieland et al, 2019). Furthermore, researchers often find themselves navigating role tensions—caught between the norms of academic science and the expectations of practical application or commercialisation (Abd Rahim et al, 2015). This dual identity can suppress proactive transfer initiatives. In addition, many researchers have limited exposure to non-academic stakeholders, which restricts opportunities for feedback, collaboration, and validation of ideas (Hayter et al., 2018).

2.2 Structural Gaps in Existing Support Systems

Although various initiatives aim to address these barriers, many fall short of meeting researchers' actual needs. Entrepreneurial frameworks have been developed to guide the alignment of research with societal needs and help identify viable use cases for innovation (Terzidis & Vogel, 2018; Lau, 2022). While theoretically robust, these frameworks are often applied in business or innovation contexts, not within research institutions. Consequently, institutional uptake remains limited, and researchers rarely engage with them (Manthey et al., 2022). A key issue is contextual fit: most frameworks overlook researchers' working realities, disciplinary logics, and identity tensions (Manthey, 2024). They are often introduced too late in the process—after ideas have already formed—leaving the early, ambiguous "fuzzy front end" of innovation unsupported (Rasmussen & Wright, 2015).

Without dedicated support tailored to researchers' specific needs—such as early market orientation or low-barrier engagement formats—many struggle to translate their ideas into real-world impact (Battistella et al., 2016; Manthey et al., 2022). Although academic entrepreneurship is increasingly acknowledged, support structures for the early research-to-impact phase remain underdeveloped. This underscores the need for researcher-oriented, stage-specific support models.

2.3 The Role of Motivation in Research Translation

Beyond structural barriers, Motivation plays a critical role in shaping whether and how researchers engage in transfer activities. While financial incentives matter, studies show researchers are primarily driven by intrinsic motivators—such as creating societal value or receiving recognition beyond academia (Urbano & Guerrero, 2013). When programmes fail to align with these internal drivers, even interested participants often disengage. Conversely, support that connects with researchers' goals and identities—while providing practical tools—can increase both engagement and transfer outcomes. This highlights the importance of approaches that combine skill development with motivational resonance and structural support.

2.4 Towards a New Model: The Rationale Behind HAFIS

These insights form the basis for HAFIS, developed as part of the Helmholtz Transfer Academies. HAFIS is designed to respond directly to the structural and motivational challenges described above. It provides tailored, researcher-centric, and motivation-sensitive support—particularly in the early stages of research translation, where uncertainty is high and conventional support often fails.

In this sense, HAFIS not only addresses structural and motivational barriers but also engages with the deeper level of organisational culture. Following Schein (2004), culture consists of shared basic assumptions that emerge as groups solve challenges of external adaptation and internal integration. By encouraging new ways of perceiving and responding to the demands of research translation—such as early-stage experimentation, stakeholder engagement, and interdisciplinary collaboration—HAFIS may contribute to the gradual evolution of these assumptions within research institutions. These emerging assumptions can, over time, become embedded in institutional routines, supporting a more sustainable and impact-oriented research culture.

3. Programme Design: The HAFIS Academy

3.1 Conceiving the HAFIS Programme

HAFIS is a nine-month programme designed to empower researchers to translate their scientific discoveries into societal and economic impact. Developed as part of the Helmholtz Transfer Academies, it is implemented across four Helmholtz centres, which are located in Germany—Karlsruhe Institute of Technology (KIT), Forschungszentrum Jülich (FZJ), Helmholtzzentrum für Schwerionenforschung (GSI), and Helmholtz-Zentrum Dresden-Rossendorf (HZDR). The programme is open to researchers from all disciplines and supports a wide range of transfer pathways, drawn from the Transferbarometer of the Stifterverband (Stifterverband, n.d.).

To design the HAFIS academy this consortium adopted a human-centred stance. For this, the leading centre, KIT, conducted 30 individual interviews of 30 to 60 minutes each with researchers from various disciplines and experience levels in 2022 — ranging from PhD candidates to postdoctoral researchers and heads of institutes. Theses interviews centred around the question of what prevents researchers from translating more of their results into impact.

In essence, their responses confirmed many of the previously mentioned shortcomings of academic entrepreneurship programmes while also revealing more specific needs of the researchers that lead to actionable insights. The most frequently discussed aspects formed the basis for the design of the HAFIS academy. Some of the most commonly mentioned topics included:

a. "*The lack of orientation"*, i.e. an overview what transfer paths for research exist beyond the omnipresent startups and industry collaborations. What's more, examples for the different paths were highly appreciated to look at own research results from a new perspective.
b. The *"ability to navigate"* the units that can provide support for the chosen transfer paths once it was found, i.e. knowing where to find what support.

c. *"Guidance, Coaching & Sparring"* help to cope with the fuzzy nature of intrapreneurship projects, i.e. researcher often sense potential in their research but struggle to identify the opportunities and application areas within it. Tailored support, methodological coaching, and sparring sessions can help.
d. In addition to their scientific responsibilities, many researchers lack sufficient internal capacity or access to external resources that can be mobilised to design and implement their projects. Connecting them with *"complementary resources"*, i.e. other entrepreneurially minded individuals who do not conduct research themselves, can be a crucial contribution to the success of these transfer projects.
e. *"Incentives and Appreciation"* for entrepreneurial behaviour are important. This includes clear recognition for activities leading to practical results from managers and supervisors as well as feedback from colleagues and members of the own community.
f. Naturally, researchers approach their topics primarily from the perspective of unsolved research questions. Thus, enabling them to *"gain a more practical perspective"* can be very insightful. Suitable approaches might include need-finding interviews, mutual exchange or even collaboration with people from relevant professional organisations and industries.

Further crucial topics mentioned by the interview partners were the need for supportive leadership, i.e. research leads who appreciate and provide freedom to pursue transfer projects, methodological enablement and education and the possibility to personally benefit from the transfer project – which in many cases is an extra-mile for those who carry it out.

These outlined needs, requirements and suggested solutions provided the cornerstones of the HAFIS design: To provide "orientation" the Transferbarometer of the Stifterverband (Stifterverband, n.d.) became a central learning content. To foster the ability to navigate offers of the transfer units of the research centres, the transfer managers in the centres became the lecturers and coaches for the researchers – because knowing and understanding each other and having an established relation matters. Moreover, coaching and sparring as well as educating approaches for human-centred innovation, (i.e. collecting data from practitioners, conducting interviews, testing prototypes etc.) became a must in the programme.

With the needs, requirements, and cornerstones in mind, several project-based learning programmes from innovation and intrapreneurship were explored and inspiration taken from them. This included among others Adobe's and Swisscom's intrapreneurship initiative Kickbox (https://www.kickbox.org/), interdisciplinary human-centred innovation courses in higher education such as the SUGAR programme (https://sugar-network.org/) and the Student Innovation Lab (https://www.kit-student-innovation-lab.de/) including the TAS-approach therein (Manthey, 2024). Apart from many detailed pedagogical and methodological elements two major impulses from this exploration were taken: a) the value of project-based learning, working on a project and receiving methodological education in parallel and b) the importance of allowing participants to work on their own projects, instead of artificial case studies. Both elements contribute to experiencing progress and impact and, thus, contribute to self-efficacy.

Moreover, the initial design of the to-be-academy was complemented by the personal, practical experience of team members with a multiyear professional background in management and innovation consulting. One key input gained from their expertise was the importance of considering both the personality and research expertise of participating researchers when supporting them in identifying potential transfer pathways. As a result, a dedicated module was integrated into the curriculum, enabling participants to reflect on their individual strengths, values, and goals. Finally, the team had the opportunity to partner with the newly formed KIT graduate school ENZo (https://www.enzo.kit.edu/english/index.php) and run a pilot cycle with their participants. The first design of the HAFIS Academy emerged from this journey. Since then, the design has been continuously reflected on, challenged, and iteratively improved.

3.2 Cornerstones of the HAFIS Design

HAFIS follows a multi-layered design that integrates three core components: milestone events, modular workshops ("Power-Ups"), and personalised sparring sessions. Together, these elements create a coherent learning journey that combines knowledge acquisition, peer collaboration, and individualised feedback (see Figure 1). In addition to fostering entrepreneurial skills, the programme aims to embed entrepreneurial thinking in research environments and drive cultural change within participating institutions.

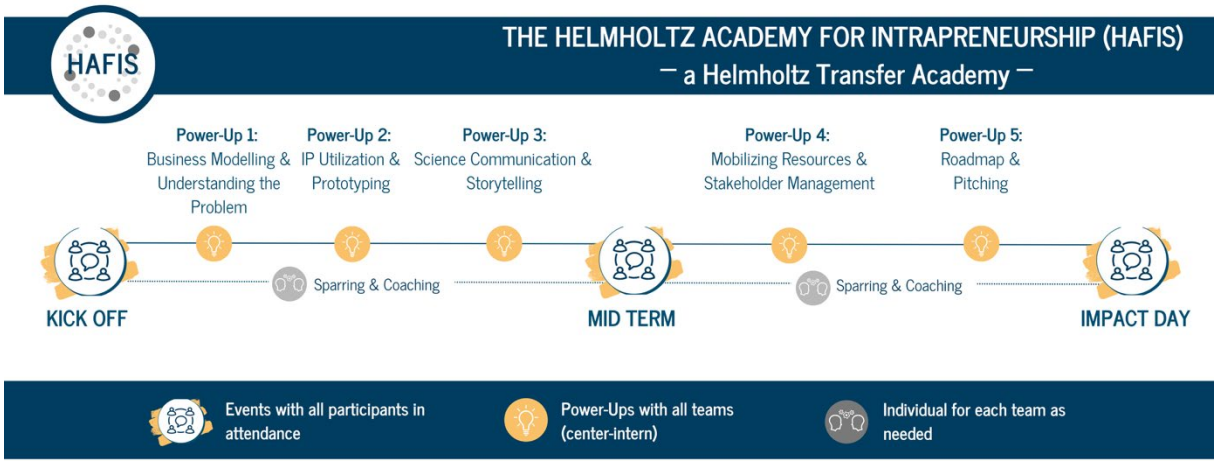


Figure 1: Structural overview of the HAFIS programme design. (own illustration)

The HAFIS learning journey is built around three milestone events: Kick Off, Mid Term, and Impact Day. Each marks a key phase in the participant experience. The Kick Off begins with self-reflection, ideation, and team formation. Participants either refine existing ideas or explore new ones through facilitated exercises. Interdisciplinary teams form across centres, supported by basic project management tools. This opening stage builds shared purpose and sets the tone for the programme. The Mid Term focuses on testing assumptions and engaging stakeholders. Participants integrate feedback, adjust goals, and clarify their next steps. The Impact Day concludes the cycle, providing a platform to present outcomes and plans to peers, coaches, and invited guests.

To support participants between milestone events, HAFIS offers five targeted workshops, or "Power-Ups," aligned with key phases of project development. Topics range from business modelling and user needs to stakeholder engagement, prototyping, and strategic communication. Early sessions emphasise value propositions, while later ones focus on refinement and pitch delivery. Drawing on established entrepreneurial tools adapted to scientific contexts, these sessions provide timely, hands-on input for ongoing project work.

A third key element is the sparring format: regular, personalised coaching sessions delivered individually or in teams. Coaches from each centre support participants in navigating project challenges, tools, and institutional dynamics, while connecting them to relevant networks. The sparring sessions foster responsiveness, accountability, and ongoing momentum throughout the programme.

4. Implementation, Iteration and Early Impact

4.1 Implementation Across Participating Helmholtz Centres

Since its launch in November 2023, HAFIS has completed two programme cycles, with the third due to begin in September 2025. Implemented across four Helmholtz centres the programme was developed to support researchers across disciplines and transfer pathways, including technology and knowledge transfer, and policy making.

In its first cycle, HAFIS recruited participants within a defined thematic focus to build a manageable and cohesive starting cohort. The second cycle, launched in late 2024 and completed end of June 2025, was opened to a broader disciplinary base. This shift was made for several reasons: the experience from the first cycle underscored the value of interdisciplinary collaboration, while continuing to impose a thematic focus risked excluding potential participants whose research did not align with it. Moreover, given the diversity of focus areas across the centres, defining a new unifying theme would have required an abstract framing that could limit relevance. Removing the thematic restriction allowed for greater inclusivity and demonstrated the programme's capacity to accommodate diverse research areas and application goals.

The first cycle began with 28 participants, of whom 21 completed the full programme. Nine project teams presented results at the final Impact Day, showcasing a range of outcomes including early-stage prototypes, structured concept documentation, and preliminary commercialisation or partnership strategies. These results suggest that the programme's design based on interviews and inspiration from related programmes—particularly its grounding in action-based learning, focus on own real-world projects, and personalised support—effectively translated into practical outcomes.

At the same time, the cycle revealed that the primary reason for participant attrition was the substantial time commitment required by HAFIS: a nine-month programme with roughly two engagement days per month. While this workload encouraged intentional commitment from most participants, it also led some to withdraw due to limited capacity alongside their core research responsibilities.

In response, the second cycle introduced several adaptations. The expected time investment was communicated more explicitly during recruitment, and the selection process was refined to place greater emphasis on participants' time commitment, project motivation, and alignment with the programme's goals. In addition, the scheduling of Power-Up sessions across centres was better synchronised, and participants were allowed to attend remotely at other locations if they were unable to join at their home centre. These changes helped reduce access barriers while maintaining programme quality and fostering a more resilient cohort.

The second cycle included 36 participants working on 18 projects. The increase in participation reflects both improved outreach and growing awareness of HAFIS within the Helmholtz community.

4.2 Programme Learning and Iterative Refinement

Consistent with its action-based learning approach, HAFIS was designed to evolve through participant feedback and reflection. Cycle 1 revealed that researchers entered with varying degrees of idea maturity—some with concrete concepts, others still exploring. To better support this range, the Kick Off in Cycle 2 was restructured to offer tailored entry points for idea development and refinement.

This change was part of a broader, multi-layered evaluation strategy that included structured surveys at the Mid Term and Impact Day, qualitative feedback at milestone events, and reflective "harvesting" exercises. Additional insights emerged informally through Power-Ups and sparring sessions. The evaluation process remained flexible, with survey instruments adapted over time to boost responsiveness. Findings were regularly shared with the Helmholtz Association through reports and presentations.

Based on this feedback, several refinements were introduced in Cycle 2. These included better timing of workshops with project phases, expanded support for prototyping and stakeholder engagement, and more flexible coaching formats to reflect growing project diversity. Optional cross-centre coaching was also piloted, enabling participants to receive feedback from innovation managers and coaches at other Helmholtz centres.

The final evaluation of Cycle 2 showed high overall satisfaction but also surfaced three key improvement areas. First, participants requested follow-on opportunities at their centres to continue project work in a semi-structured format post-HAFIS. Second, they noted difficulty securing focused time for their projects and suggested an intensive joint work session—such as a sprint, hackathon, or 24-hour camp—integrated with milestone events. Third, several teams struggled to find partners with complementary skills, highlighting the need for improved match-making and team formation formats.

Together, these insights illustrate HAFIS's ability to adapt to participant needs and continually strengthen its support structures based on lived experience.

4.3 Indicators of Cultural Change and Early Outcomes

Beyond measurable outcomes, HAFIS shows early signs of cultural impact at both individual and institutional levels. Informal feedback, observations, and qualitative notes from milestone events suggest that participants gained confidence in using entrepreneurial tools and showed a greater willingness to pursue transfer beyond academic boundaries. These insights often emerged toward the end of the programme, reflecting gradual internalisation. Several collaborations initiated during HAFIS have continued beyond the formal programme, indicating emerging networks and sustained peer exchange. This is interpreted as a sign of increased ownership, perseverance, and impact orientation—hallmarks of entrepreneurial behaviour.

Cycle 2 further underscored intercultural competence as a key learning outcome. With participants from diverse national and disciplinary backgrounds, the programme fostered cultural awareness and cross-perspective teamwork—skills transferable to broader international contexts.

Visibility efforts supported these shifts. Participants from both cycles were introduced via LinkedIn to raise their professional profiles and signal institutional support. The public presentation of project outcomes—initially delayed—now follows the conclusion of the second cycle and will be promoted ahead of the third, via the HAFIS website and internal communication channels.

Feedback from coaches and partners suggests growing openness to innovation-oriented formats. Even beyond the immediate cohort, dialogue on entrepreneurial engagement has increased—pointing to HAFIS's potential to foster a more impact-oriented research culture.

5. Discussion

Interim results highlight HAFIS's potential as a model for fostering entrepreneurial thinking and addressing persistent barriers to research transfer. Through structured milestones, targeted workshops, and personalised coaching, HAFIS supports a broad spectrum of transfer pathways—from commercialisation to policy engagement and interdisciplinary exchange.

A key distinguishing feature is its human-centred, iterative design, which adapts based on participant feedback. Changes between the first and second cycles—such as differentiated Kick Off entry points—illustrate responsiveness to participants' varying starting positions. The formation of cross-centre task forces, implementation notes, and inter-team exchanges signal improved coordination and organisational learning.

Despite this progress, several challenges remain. Maintaining engagement over nine months is demanding, especially given competing academic duties. Institutional cultures often prioritise traditional metrics over transfer efforts, making cultural change difficult to measure—though participants increasingly report a shift in how they perceive research impact. Geographic distance among centres and varying experience levels complicate collaboration and design consistency.

Some overlap with local transfer programmes also posed coordination issues, prompting reflection on audience clarity and institutional communication. HAFIS responded with hybrid formats and clearer messaging, but further adaptations—such as shorter milestones or incentivised check-ins—may enhance sustained engagement. These tensions are not unique to HAFIS but reflect broader challenges in innovation-focused academic programmes.

Compared to other initiatives, HAFIS offers distinct features. Programmes like SUGAR or Adobe's Kickbox prioritise rapid iteration and design thinking but are often student- or corporate-focused. Incubators typically serve researchers with concrete start-up ideas. HAFIS instead targets the early-stage "fuzzy front end" of research translation, where support is often lacking. Its researcher-centric, extended format and integration with institutional transfer structures distinguish it within intrapreneurial education.

HAFIS also aligns with broader institutional goals to embed entrepreneurial thinking in academic research (Manthey et al., 2022). Rather than a one-time training, it emphasises iterative learning, long-term engagement, and interdisciplinary peer exchange. These elements address known barriers to academic entrepreneurship—particularly the disconnect between research and application, and the need for cultural transformation within research institutions (Müller-Wieland et al., 2019).

6. Conclusion

HAFIS illustrates how a thoughtfully designed, feedback-driven programme can cultivate entrepreneurial competencies among researchers while promoting cultural change within scientific institutions. Through its combination of structured events, practice-oriented workshops, and individualised coaching, HAFIS supports researchers in navigating the uncertainties of early-stage transfer and in translating scientific insights into societal or economic value.

Across its first cycle and the second cycle, the programme has grown in participation, diversified its disciplinary reach, and enabled a range of tangible project outcomes. These include prototypes, transfer roadmaps, and new collaborations. More importantly, HAFIS has contributed to a shift in mindset among participants—helping them see entrepreneurship not as a departure from science, but as a complementary avenue for real-world impact.

While challenges remain, such as sustaining engagement over time and fostering cross-institutional collaboration, the programme iterative design has shown clear value in identifying and adapting to many of these hurdles. Moving forward, greater efforts will be made to raise HAFIS's visibility through LinkedIn and other strategic channels—both to support participant visibility and to communicate success stories more broadly. Initiated developments—including optional cross-centre coaching, shared workshop delivery between neighbouring centres, and the integration of Impact Day into larger innovation conferences—offer promising paths for strengthening the programme's reach and long-term sustainability.

Compared to conventional training programmes, HAFIS emphasises experiential, project-based learning over theoretical instruction. This approach aligns with broader trends in entrepreneurship education and has shown particular promise in scientific environments where researchers may initially be unfamiliar with entrepreneurial practices. By embedding learning into researchers' daily work and identity, HAFIS not only builds individual capacity but also reinforces institutional readiness for innovation.

Beyond its immediate context, HAFIS offers a scalable model for other research institutions aiming to foster impact-oriented research cultures. Its focus on interdisciplinary exchange, personalised support, and cultural transformation positions it as a relevant model within ongoing European and international discussions on academic entrepreneurship and research impact. The insights from the first two cycles affirm the programme's potential to be further expanded and refined—not only within Helmholtz but across other publicly funded research organisations committed to bridging the gap between science and society.

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Ethics Declaration

This study did not involve human subjects, personal data, or sensitive information requiring formal ethical approval. Therefore, ethical clearance was not required.

AI Declaration

This paper was developed with support from OpenAI's ChatGPT-4. The tool was used to support editorial refinement, language polishing, and structural coherence. All content was critically reviewed, validated, and edited by the authors to ensure accuracy and original scholarly contribution.

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Work in Progress Papers

The Dual Impact of AI on Burnout and Technostress in Manufacturing Workplaces

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Abstract: This research investigates the complex relationship between Artificial Intelligence (AI) and employee well-being in the manufacturing sector of Metropolitan Lima, with a focus on the growing concerns of burnout and technostress. As AI technologies are increasingly implemented in industrial environments, new questions arise: can these tools simultaneously be a cause of stress and a solution for it? The study follows a critical research approach, aiming to question and evaluate the social and organizational consequences of digital transformation. Methodologically, it adopts a mixed-methods design. On one hand, the research is empirical and quantitative, based on structured surveys conducted with manufacturing workers, assessing their stress levels, perceptions of AI, and workplace experiences. On the other hand, it incorporates a qualitative component, drawing from secondary data sources such as industry case studies, academic literature, and policy documents, to contextualize and deepen the analysis. A central line of inquiry is how AI driven systems are perceived by workers: are they tools for support, or instruments of control and surveillance? The study explores how these perceptions influence technostress and burnout, considering factors such as digital workload, perceived autonomy, and job security. Simultaneously, the potential of AI to serve as a preventive tool, monitoring well-being indicators, detecting early signs of emotional exhaustion, and enabling tailored interventions is critically examined. The findings of this study are expected to offer practical value to HR professionals, organizational leaders, policymakers, and technology designers. They provide insight into how AI can be implemented in ways that support mental health, enhance job satisfaction, and create more sustainable and inclusive work environments. Moreover, the research aligns with the United Nations Sustainable Development Goals (SDGs), especially those focused on promoting decent work and well-being. By framing AI as both a challenge and an opportunity, this study invites a deeper discussion about how to humanize technological innovation in labour-intensive industries undergoing digital transformation.

Keywords: Artificial Intelligence (AI), Burnout, Technostress, Workplace well-being, Productivity, Manufacturing sector.

1. Introduction

Artificial intelligence (AI) in the workplace brings both benefits and challenges, especially in high-demand sectors like manufacturing in Lima (Pooja, 2024). While AI streamlines repetitive tasks and boosts efficiency, it also increases surveillance and performance pressure, leading to “technostress” a form of stress triggered by the demand to match machine-like productivity (Brod, 1984). In Peru, the manufacturing sector grew by 18.6% in May 2024, signalling economic recovery but also adding productivity pressure (Ministry of Production, 2024). Although AI may ease workloads, it can simultaneously heighten emotional strain. Burnout, marked by exhaustion, depersonalization, and reduced personal accomplishment (Freudenberger, 1974; Maslach & Jackson, 1986), is exacerbated by poor working conditions and excessive demands. Globally, depression and anxiety result in 12 billion lost workdays and nearly one trillion dollars in losses each year (WHO & ILO, 2022). Manufacturing, central to the Fourth Industrial Revolution, benefits from AI through predictive maintenance and supply chain optimization (Díaz-Olivan, 2024), yet adoption is limited by technological complexity and organizational resistance (Çinar, 2020). Tools like chatbots and virtual assistants can reduce stress by automating tasks and offering personalized support (Tiwari, 2024), and AI systems may track behavioural indicators to enable early intervention (Olawade, 2024). In Peru, where manufacturing contributes 12.5% to the national GDP, digital transformation is advancing rapidly, increasing pressure on workers to adapt. Feelings of incompetence in handling technology may lead to frustration and demotivation, accelerating emotional exhaustion (Ragu-Nathan, 2008). As burnout affects professionals across sectors (Golembiewski, 1991), broad-based strategies are essential. Understanding AI’s impact on technostress and burnout in Lima’s manufacturing sector is critical to balancing technological progress with mental well-being in the evolving world of work.

2. Theoretical Model and Hypotheses

Artificial intelligence (AI) presents an ambivalent challenge in the workplace. While AI systems improve efficiency by automating repetitive tasks, they can also raise performance expectations and intensify digital surveillance, leading to technostress and burnout (Kaplan and Haenlein, 2019). This study explores four hypotheses: (H1) AI use directly impacts burnout through technostress; (H2) AI use is inversely related to burnout; (H3) AI use directly influences technostress; and (H4) technostress contributes to burnout among manufacturing workers in

Lima in 2024. Although AI enhances productivity, it may also create feelings of being monitored and easily replaced, increasing anxiety and job insecurity (Reinhold and Järvis, 2020). In unstable work environments, AI can reduce motivation and heighten emotional exhaustion (Rodríguez Carvajal and Rivas Hermosilla, 2011). However, AI also holds potential for preventing burnout by identifying early signs of stress using sensors and predictive algorithms (Rojas-Bolaños et al., 2020) and has been shown to support resilience in fields like education (Martínez-Ramón and García-González, 2023). Still, role automation may add workload and ambiguity (Ayyagari, 2011), and the perception of constant monitoring can further increase stress (Garcia-Maduraga, 2024). Despite these concerns, AI can support personalized well-being strategies through predictive tools (Wayzman, 2024). Technostress is linked to fatigue, low motivation, and dissatisfaction due to digital complexity and blurred work-life boundaries (Babiker, 2024). Although long-term tech exposure can lead to burnout, this risk decreases with proper organizational support (Meyer and Tisch, 2024). Assessing AI's impact is difficult given variations in workplace culture, sector, and perception. While AI may ease workload, it can also increase stress via surveillance and high expectations (Reinhold and Järvis, 2020). Workers' views are shaped by experience, job security, and socioeconomic context. Despite rising attention to technostress, research often lacks local relevance (Cuervo et al., 2020), as most studies originate from highly developed regions. A broader, more inclusive perspective is essential to evaluate AI's true role in mental health and sustainable workplace transformation.

3. Methodology

This study adopts a quantitative applied approach, focusing on the collection and analysis of numerical data to test hypotheses and explore relationships between burnout, technostress, and artificial intelligence (AI) (Hernández et al., 2014). It uses a non-experimental, cross-sectional design, observing phenomena in their natural context at a single point in time without manipulating variables. The study is correlational in scope and does not seek to establish causality. The target population consists of men and women aged 25-44 working in administrative and production areas of medium and large manufacturing companies in Lima in 2025 a sector selected for its national economic importance, contributing 12.7% to GDP and generating 88% of national employment (Webb, 2013; Ministerio de la Producción, 2022). The finite sample includes 384 individuals, determined using a 95% confidence level and 5% margin of error, and selected through judgmental non-probability sampling appropriate for PLS-SEM analysis. Data will be collected via email surveys, an efficient method for quantitative research (Hernández et al., 2014), with secondary sources including Scopus, Scielo, Web of Science, Google Scholar, and INEI. Instruments include structured questionnaires aligned with each variable: burnout will be measured using the Maslach Burnout Inventory General Survey (MBI-GS), validated by high internal consistency ($\alpha \leq 0.85$) (Moreno-Jiménez et al., 2014); technostress will be assessed using the Technostress Creators Scale, which includes five subdimensions and demonstrates strong reliability ($\alpha \geq 0.89$); and AI will be measured using the Generative Artificial Intelligence Instrument, with an excellent Cronbach's alpha (≥ 0.909), indicating high internal consistency and suitability for this research.

4. Results

The quantitative analysis of this study was conducted using the partial least squares structural equation modelling method, aiming to evaluate the proposed model and empirically validate the hypothesized relationships among the variables: artificial intelligence, technostress, and burnout. Data were gathered through surveys applied to 384 workers from the manufacturing sector in Metropolitan Lima.

First, the quality of the model was assessed using several validity and reliability indicators. The model fit was acceptable, as reflected by the SRMR value, which although not explicitly stated, can be inferred to fall within an acceptable range considering the strength and consistency of the remaining results. Internal consistency was verified using Cronbach's alpha and composite reliability. The Cronbach's alpha values were 0.939 for burnout, 0.963 for artificial intelligence, and 0.948 for technostress. Composite reliability also surpassed the recommended threshold of 0.7 in all cases, reaching 0.961 for burnout, 0.970 for artificial intelligence, and 0.960 for technostress. The average variance extracted also supported strong convergent validity, with values of 0.890 for burnout, 0.821 for artificial intelligence, and 0.828 for technostress.

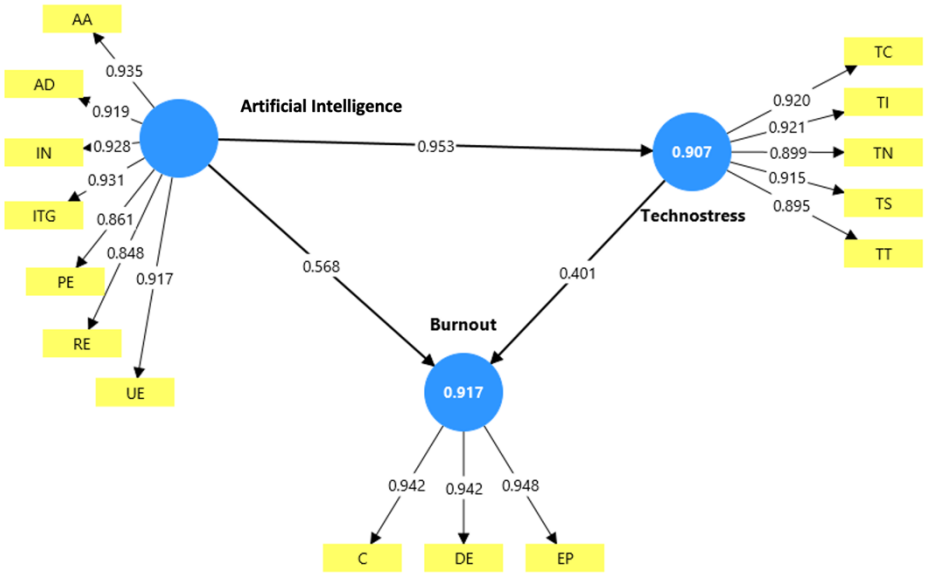


Figure 1: Structural model showing the effects of Artificial Intelligence on Technostress and Burnout. Source: Output generated with SmartPLS 4.

Table 1: Model Fit

	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
Burnout	0.939	0.939	0.961	0.890
Artificial Intelligence	0.963	0.965	0.970	0.821
Technostress	0.948	0.949	0.960	0.828

Source: Output generated with SmartPLS 4.

Discriminant validity was verified using the Fornell-Larcker criterion. The square root values of the AVE were greater than the correlations between constructs, supporting the conceptual distinction among variables. Despite high cross-correlations, for example between artificial intelligence and burnout (0.950), the values on the diagonal remained dominant, indicating that the items more strongly represented their own constructs.

Multicollinearity was assessed using the variance inflation factor, and all VIF values were below the critical value of 10, confirming that multicollinearity does not significantly distort coefficient estimation in the model.

Table 2: Fornell-Larcker Criterion

	Burnout	IA	Technostress
Burnout	0.944		
Artificial Intelligence	0.950	0.906	
Technostress	0.942	0.953	0.910

Source: Output generated with SmartPLS 4.

Table 3: Collinearity Statistics

	VIF
AA	5.926
AD	4.881
C	4.065

	VIF
DE	4.114
EP	4.409
IN	5.396
ITG	5.619
PE	3.002
RE	2.797
TC	4.201
TI	4.222
TN	3.432
TS	3.965
TT	3.337
UE	4.674

Source: Output generated with SmartPLS 4.

The structural model analysis revealed that artificial intelligence has a strong positive effect on technostress, with a path coefficient of 0.953, a t-value of 255.853, and a p-value below 0.001. There was also a significant direct effect of artificial intelligence on burnout, with a coefficient of 0.568, a t-value of 12.141, and a p-value below 0.001. Furthermore, technostress had a positive and significant impact on burnout, with a coefficient of 0.401, a t-value of 8.420, and a p-value below 0.001. The model showed high explanatory power, with R-squared values of 0.917 for burnout and 0.907 for technostress, indicating strong predictive accuracy.

Table 4: Path Coefficients

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Artificial Intelligence -> Burnout	0.568	0.568	0.047	12.141	0.000
Artificial Intelligence -> Technostress	0.953	0.953	0.004	255.853	0.000
Technostress -> Burnout	0.401	0.401	0.048	8.420	0.000

Source: Output generated with SmartPLS 4.

5. Discussion

The results allow a detailed assessment of the research hypotheses and offer valuable insights into the relationships between artificial intelligence, technostress, and burnout in the manufacturing sector in Lima. The general hypothesis that proposed a mediating effect of technostress in the relationship between artificial intelligence and burnout is supported by the findings. The significant paths from artificial intelligence to technostress and from technostress to burnout demonstrate that technostress partially mediates the effect of artificial intelligence on burnout. The presence of both a direct and an indirect effect confirms this partial mediation.

The first specific hypothesis, which proposed that artificial intelligence has an inverse impact on burnout, was not supported. On the contrary, a positive coefficient was found, suggesting that in this context the use of artificial intelligence may be contributing to increased levels of burnout. This could be explained by employees feeling pressured to adapt, fearing replacement, or experiencing an increase in cognitive demands due to technological tools. The second specific hypothesis, which posited a direct positive relationship between artificial intelligence and technostress, was confirmed. The strength of this relationship reflects the psychological pressure that may result when workers are exposed to advanced digital systems without sufficient training or support. The third specific hypothesis, which proposed that technostress has a direct effect on burnout, was also confirmed. High levels of technostress, characterized by informational overload, digital overexposure, and

uncertainty about technological tools, were strongly associated with emotional exhaustion and reduced professional well-being.

Altogether, these findings suggest that artificial intelligence can play a dual role in the workplace. Rather than being inherently beneficial or harmful, its effects on employee well-being depend on the conditions of its implementation. Proper integration of artificial intelligence, alongside training, support, and clear communication, could mitigate technostress and reduce the risk of burnout. Conversely, the absence of these organizational measures may exacerbate psychosocial risks and lead to increased emotional strain.

6. Conclusion

In conclusion, the integration of artificial intelligence (AI) in manufacturing offers both benefits and risks for worker well-being. While AI improves task efficiency and can detect early signs of stress, it also increases concerns about surveillance, job insecurity, and pressure to perform—factors linked to technostress and burnout. This study finds that AI's impact on mental health is shaped by organizational context and employee perceptions. Technostress plays a key role, acting as both a mediator and an outcome of poor adaptation. Companies should pair digital transformation with human-centered strategies that foster resilience and psychological safety. Future research should address sector-specific and cultural factors to ensure sustainable, health-focused AI implementation.

Ethical Declaration

This study did not require ethical clearance as it relied entirely on secondary data obtained from published research articles. No human participants were involved, nor were any new data collected.

AI Declaration

This article used ChatGPT (OpenAI 2025) to facilitate editing, grammar checking, and translation. All AI-generated content was reviewed and paraphrased by the author to ensure accuracy, originality, and compliance with academic standards.

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Understanding Minimalistic (Non-)Consumption Patterns: Implications for Innovative Responsible Business Practices

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Abstract: The rise of minimalism reflects a broader societal shift away from consumerism, as individuals seek fulfilment beyond material possessions. Minimalists prioritize sustainability, simplicity, and intentional living, challenging traditional consumer behaviours. This paper explores the mindsets and behaviours of minimalists and examines their implications for businesses aiming to adopt responsible and ethical practices. Through 20 semi-structured interviews with minimalists in Germany, the research uncovers how minimalists make consumer choices, highlighting their focus on experiences, meaningful relationships, and personal growth over the accumulation of material goods. The findings suggest that innovative businesses have significant opportunities to align with these evolving preferences by offering durable, multifunctional products designed for meaningful use. Furthermore, innovative companies can create experiences that encourage community, authenticity, and personal development, positioning themselves as pioneers of sustainable and responsible practices in a changing consumer landscape.

Keywords: Minimalism, Consumption, Sustainability, Responsibility, Voluntary Simplicity

1. Introduction

Many entrepreneurs are driven by environmental or societal goals rather than personal gain (Smadi – Delcheva, 2021, p. 293). Sustainable entrepreneurs prioritize social responsibility and use renewable resources to improve their environment (Laverty & Littel, 2020, p. 117). Often viewed as "paradigm shifters", they apply creative thinking to innovation. To foster innovation, entrepreneurs must stay aware of global and local competition and identify emerging market trends (Smadi – Delcheva, 2021, p. 293).

Marketers have adopted "Minimalism" as a trendy lifestyle for campaigns promoting luxury goods, clothing, and furniture (Doppler & Steffen, 2024, p. 1). While minimalism is gaining popularity in mainstream culture, often emphasizing reduced consumption and decluttering (Wilson & Bellezza, 2022), marketers are using it to sell luxury items. This article distinguishes between the lifestyle of minimalism, for which people reduce their consumption, and minimalism as a trend, which is used by firms to promote products, and answers the following research question: In which ways can innovative entrepreneurs apply minimalist principles to product marketing?

2. Literature Review

2.1 Introduction to Minimalism as a Lifestyle

Minimalism as a post-capitalist lifestyle is currently developing rapidly, particularly formats like “Tidying up with Marie Kondo” (Kondo, 2014) or “The Minimalists” (The Minimalists, n. D.) have brought minimalism into mainstream consumer culture. However, there seems to be a misconception amongst marketers about the meaning of minimalism and how people who practice minimalism interpret and live a minimalistic lifestyle.

Many marketers are trying to integrate the concept into their product portfolio. They are using a market development strategy to communicate existing products accordingly (e.g. Ikea ‘Modern Scandi Style: Minimalist and bright home’, Ikea, n.d.) or with a diversification strategy to develop specifically minimalistically designed products (e.g. Calvin Klein ‘Confident Minimalism’, Calvin Klein, autumn 2023 campaign). Such market strategies understand minimalism as a consumer trend and are not to be confused with the idealistic notion of minimalism that those people have who practice this lifestyle.

2.2 Definition of Minimalism

There is still not a commonly used definition of minimalism in literature, which is due in part to the fact consumer minimalism may take many different forms. Derwanz (2015) sees the lifestyle and the change of

consumption habits as fundamental to define minimalism, Wilson & Belezza (2022, p. 800) place the quantity of possession, a rigid aesthetic, and consciously curated consumption at the center of their definition.

Minimalism refers to a low-consumption lifestyle (Lloyd & Pennington, 2020) which is characterized by a change in consumption (Derwanz, 2015), anti-consumption practices (Dopierała, 2017, p. 69), and a focus on simplicity (Lloyd & Pennington, 2020). It is a lifestyle and an intrinsic attitude which inspires people to focus on the essential, regardless of societal trends. Everything that is perceived to be of value e.g. that creates happiness and meaning to the individual is considered essential. Minimalism is an ongoing process that helps individuals to create order, time and freedom (Doppler & Steffen, 2024, p. 12).

3. Methodology and Sample

Two senior researchers conducted 20 semi-structured in-depth expert interviews with people who consider themselves to be minimalists in Germany. The sample consisted of 12 females and 8 males between the ages of 28 and 55 who all practice minimalism voluntarily. None of the participants live a reduced lifestyle because of financial needs or job loss. The interviewers asked participants about their definition of minimalism, their motivation for living a minimalistic lifestyle, consumption habits and personal consequences of living a minimalistic lifestyle. The responses were transcribed, coded and analyzed systematically with the data analysis software MAXQDA.

4. Results

4.1 Mindset of Minimalists

The study participants all explained that they feel very happy with their lifestyle. Although they consume little, but very carefully, they do not miss anything. They prioritize experiences, meet up with friends and develop meaningful relationships. They strive for personal growth rather than to accumulate many items. The study participants own between 270 and 400 items. This is a big contrast to approximately 10.000 items that a typical German household possesses (Doppler & Steffen, 2024, p. 30) or the 300.000 items a typical American household has (MacVean, 21.03.2014).

4.2 Purchase Behaviors and Product Preferences of Minimalists

The interview analysis shows that minimalists do not generally avoid consumption. Products are consumed regardless of fashion and seasonal trends. Figure 1 shows the 5 levels of assessment minimalists go through when making product purchases. Consumption of minimalists is more carefully reflected on several levels before a decision is made.

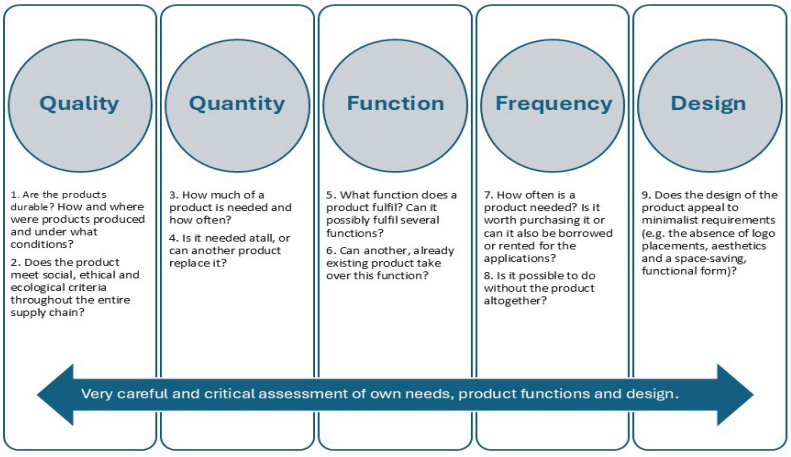


Figure 1: Minimalists` 5 levels of critical and reflective consumption assessment

The analysis also shows that Minimalists limit their media consumption by avoiding television and newspaper subscriptions. When they do consume media, it is intentional and on-demand. Instead of excessive media use, they prefer outdoor activities, spending time with loved ones, or reading. Some minimalists aim to use their devices until the end of their life cycle, which may lead to issues like incompatible apps, poor content quality, limited storage, or small screens.

5. Recommendations for Innovative Entrepreneurs

Entrepreneurs recognize that environmental protection is vital for long-term business success (Laverty & Littel, 2020, p. 118). The UN's 12th Sustainable Development Goal promotes sustainable consumption and production to drive business and lifestyle changes (Umweltbundesamt, n.d.). As consumers increasingly expect responsible behaviour, businesses are shifting toward sustainability (Maloney & Meurer, 2023, p. 259). Minimalism, promoting sustainability and purpose, challenges traditional consumer culture. While minimalists consume less, their product choices often align with non-minimalists, making them a relevant target for businesses.

5.1 Strategy and Business Model

To reach minimalist or consumption-critical consumers, businesses should consider rental, subscription, exchange, and second-hand options, already established in the mobility sector (e.g., bicycles, cars, e-scooters). These models could be applied to seasonal or infrequently used items like tools, games, and kitchen appliances. For example, Decathlon's 'Second Use' program offers sports and camping products in categories such as 'as new,' 'very good,' and 'good' both in stores and online (Steffen, 2023, p. 333).

To connect with minimalist and discerning consumers, businesses must gain a deep understanding of their values and earn their trust. Traditional marketing, which focuses on immediate responses, is less effective. Instead, companies should focus on the social and ecological impacts of their products, shifting from image-driven content to informative content series (Plaschke, 2020, p. 30). Minimalists and discerning consumers prefer transparent, fact-based unbiased information to make independent purchasing decisions.

Thompson & Norton (2011) noted the trend of "feature creep," where products are overloaded with features that, while expensive and reducing usability, signal technological sophistication. To better serve minimalists, businesses should prioritize simplicity and functionality. Minimalists can contribute to product design, particularly in "pluralism of use," where products serve multiple functions with a reduced design (e.g., multifunctional appliances or versatile clothing). Businesses could involve minimalists in co-creating or redesigning products in product development workshops e.g. by asking the nine questions outlined in Fig. 5.

5.2 Product Marketing

Providing reliable, accessible information on a product's entire life cycle is essential for minimalists when making purchasing decisions. A circular economy and transparency in materials, manufacturing, and disposal are critical. Businesses should share disposal or recycling options early in the product's life cycle—even before purchase.

For food and hygiene products, offering flexible quantities and packaging sizes benefits environmentally conscious consumers and minimalists. Unpackaged options let them buy only what they need, minimizing waste and supporting sustainable consumption.

Traditional segmentation based on age, gender, or income (Solomon, 2016, p. 11) is less relevant for minimalists. Instead, they should be seen as "communities of values," guided by sustainability, simplicity, and purpose (Solomon, 2016, p. 76).

6. Conclusion and Limitations

Innovative entrepreneurs can succeed financially by developing products and services based on minimalist ideas. These products should be long-lasting, versatile, and designed for specific purposes. They can also create experiences that foster community, authenticity, and personal growth—reflecting the relational and experiential values of minimalists.

To reach minimalists and consumption-critical consumers, communication should extend beyond company channels to where the community engages. In corporate communication, minimalist values can be emphasized by highlighting quality over quantity, reducing resource use, and promoting well-being, satisfaction, and health. Ethical, social, and ecological responsibility should be integrated to encourage behavior that benefits the common good. Traditional influencer marketing is ineffective, as minimalists limit digital consumption and distrust influencers. Instead, companies should build in-house expertise, with employees sharing tips on product care, repairs, and second-hand options via social media.

This research is limited to interviews with minimalists and does not reflect the perspectives of non-minimalists on minimalist practices. Additionally, minimalists were not directly asked about product requirements in the

context of product development. Future research should address these gaps and include interviews with entrepreneurs as well.

Ethics Declaration

Ethical approval was not required as the study involved voluntary adult participants who received information about the study and gave verbal consent. No funding was received, and the authors declare no conflict of interest.

AI Declaration

The authors declare that no generative AI was used in the creation of this manuscript. DeepL Translate, DeepL Write and Quillbot were used to correct grammar and improve language.

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Late Submissions

A Tale of Artificial Intelligence and Green Marketing: Shaping Smarter Paths to Sustainability

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Abstract: This study explores the transformative potential of artificial intelligence in shaping the future of green marketing. Utilising a scoping review methodology, in accordance with the PRISMA-ScR checklist, pertinent studies were systematically extracted from the Scopus database, concentrating on publications from 2020 onwards. The review catalogues publication venues, annual research trends, and subject focuses. Research indicates that conference papers predominate in the discipline, with Asian countries emerging as key contributors to knowledge generation. This study emphasises AI as both a technology facilitator of sustainable marketing and a catalyst for reevaluating consumer–brand relationships concerning environmental responsibility. There exists an opportunity to integrate diverse elements, including digital customer experience, blockchain, generative AI, agentic AI, sustainability practices, green advertising, social media platforms, the Internet of Things (IoT), and the circular and green economy, into green marketing and AI, while analysing various sectors and domains in conjunction with AI and green marketing. This study integrates AI innovation with environmental consciousness, establishing AI-enabled green marketing as a domain for academic research and practical change.

Keywords: Artificial Intelligence, Marketing, Green Marketing, Suitability, Consumer Behaviour

1. Introduction

Addressing the importance of artificial intelligence (AI) to green marketing (GM) is crucial, as it helps predict future customer behaviour (Sohaib et al., 2025). Researchers and businesses are both investing with great interest in the application of AI in green marketing, as more studies have started to be published in this regard, emphasizing sustainability. The field of marketing has undergone a dramatic transformation due to the rise in interest in AI, providing management with the opportunity to make informed decisions, whether in predictive analytics and trends, or in optimizing their processes (Chintalapati and Pandey, 2022, Vlačić et al., 2021). Green marketing is gaining prominence as firms adapt their strategies to reflect both sustainability commitments and customer expectations (Majeed et al., 2022). In practice, artificial intelligence provides tools that can make such initiatives more cost-effective and transparent, thereby linking environmental accountability with competitive advantage (Zhou and Jiang, 2025).

The implementation of AI has dramatically transformed the landscape of business processes, enabling firms to make more informed decisions on their processes. Organizations can optimize their green marketing strategies while simultaneously meeting the standards of sustainability and profitability (Can et al., 2023, Huh, 2016). This AI method in GM helps firms forecast consumer behaviour, anticipate shifts in sustainability preferences, and automate their eco-friendly marketing strategies. Nevertheless, these businesses have ethical concerns, presenting a quandary about resolving issues such as ensuring openness, accountability, and mitigating bias. It is imperative to address these difficulties to uphold social responsibility requirements meticulously (Hermann, 2022, Vlačić et al., 2021).

Despite the numerous and growing advantages of implementing AI in green marketing, the subject remains insufficiently investigated in several domains. This study addresses the deficiency by examining the application of AI in green marketing, encompassing its effects, ethical dilemmas, and current research avenues. This inquiry is guided by the subsequent research questions:

RQ1: What is the importance of artificial intelligence in developing green marketing?

RQ2: What are the publication trends by year?

RQ3: What are the sources of publication?

RQ4: What countries publish more papers on contextual analysis?

The study aims to enhance our understanding of how AI can facilitate green marketing. It will highlight the deficiencies in the extant literature and highlight new avenues for research. The outcomes of this research will

contribute to both academic research and practice, offering valuable insights for businesses seeking to grow sustainably with the use of AI-driven solutions.

This paper is outlined as follows: Section I start with the introduction of the study and addressing research questions. Section II clarifies the definitions and foundations of artificial intelligence and green marketing. Section III delineates the research methodology and design. Section IV articulates the findings, encompassing trends and obstacles in AI-enhanced green marketing. Section V presents a discussion of the implications for research and practice, culminating in the conclusion in Section VI, which highlights the study's key contributions and suggests directions for future research.

2. Literature Review

Researchers and Scholars are increasingly researching how AI can be implemented in marketing to help marketing managers address environmental challenges and enhance their green marketing operations. Especially since there is a growing call to help address environmental challenges, AI can provide innovative solutions and contribute to sustainable practices. Furthermore, AI provides enriching insights, enabling companies to connect more effectively with environmentally conscious consumers. By combining predictive trends with the focus of green marketing on sustainability, businesses can grow responsibly, considering sustainability.

2.1 Artificial Intelligence

Artificial intelligence (AI) is widely recognized as one of the most transformative technological developments of recent decades. Rather than replacing human cognition, its primary role is to complement and extend it by allowing machines to undertake tasks such as complex data analysis, recognition of patterns, and informed decision-making—activities that previously depended almost entirely on human expertise (Mustak et al., 2021). Within academic literature, AI is commonly described as the design and deployment of intelligent systems, particularly advanced computer-based applications. Chen et al. (2024) further emphasize that AI represents machine-driven intelligence, involving the perception, interpretation, and synthesis of information, which sets it apart from human reasoning processes.

The rapid adoption of AI across industries has therefore become a significant focus for researchers, as organizations steadily integrate AI tools into their operations. Can et al. (2023) refer to this ongoing shift as “AI-oriented development,” highlighting the intentional use of AI in decision-making, investment planning, and organizational governance. Li et al. (2023) extend this argument by framing “AI orientation” as an organizational capability that reflects how strategically firms employ AI technologies to secure competitive advantage across sectors. Yet, as AI becomes more deeply embedded in business functions, managers and leaders are increasingly required to grapple not only with its potential benefits but also with the strategic, ethical, and societal challenges that such technologies inevitably introduce.

2.2 Green Marketing

Green Marketing (GM) is defined as the promotion of products and services based on their environmental benefits (Iannuzzi, 2012). The idea of green marketing is to reduce environmental effects (Bogdana, 2024, Nayak et al., 2024), and to support consumer choices on sustainable products and services. Moreover, it includes strategies such as the development and promotion of environmentally friendly products (Mourya and Verma, 2024). The adoption of green packaging and sustainable distribution strategies, and the application of communication strategies that enhance consumer awareness about green-conscious habits (Alrizki and Dewi, 2024). As well as, the integration of lifecycle assessments and environmental impact analyses to guide decision-making processes (Nayak et al., 2024, Sharma and Singh, 2025). Firms are increasingly faced with the challenge of mitigating the negative impacts of their operations while promoting environmentally conscious consumer practices. Responding effectively requires more than compliance; it involves a clear understanding of customer preferences, market shifts, and the ongoing evolution of environmental legislation. As a result, sustainability cannot be approached as a symbolic gesture. Instead, organizations must demonstrate a genuine commitment by integrating environmental concerns into their everyday practices, policies, and strategic directions.

2.3 Current State of Green Marketing

In recent years, the role of green marketing has grown steadily, though not always in the same way across industries. Some companies treat it as a central strategic pillar, while others use it more narrowly as a branding tool. As Huh (2016) observes that customers are increasingly attentive to environmental and social factors when making choices, sometimes even prioritizing these over traditional concerns, such as price or convenience. This shift is gradual but visible, and it forces businesses to rethink how sustainability fits within the marketing mix. In response, businesses have been experimenting with different approaches to demonstrate social and environmental responsibility. Hossain et al. (2025) indicated that there are several aspects including redesigning product features to emphasize eco-friendliness, adjusting supply chain practices to minimize waste, and promoting brand identities that emphasize ethical and sustainable values. Such strategies reveal how corporate sustainability is moving from a peripheral concern to a central determinant of competitive positioning.

2.4 Role of AI in GM

AI is now frequently discussed as a mechanism for enhancing sustainable marketing strategies. It enables more precise data analysis, personalized consumer interaction, and process automation, which collectively allow firms to strike a balance between efficiency and environmental commitments. For instance, AI tools have already been applied in areas such as optimizing renewable energy consumption, minimizing emissions, and re-designing operations to align with eco-friendly business models (Balcıoğlu et al., 2025).

Through AI, managers can also refine how products are developed, priced, and communicated to customers. Research suggests that AI adoption provides firms with deeper insights into consumer behaviour while simultaneously mapping the environmental implications of market trends (Hue and Hung, 2025, Jain and Kumar, 2024). This flexibility permits marketing strategies to be recalibrated in ways that more directly support sustainability agendas.

Moreover, AI has the potential to transform specific green marketing activities. For example, advanced analytics can be used to process environmental data, improve supply-chain sustainability, and design campaigns that resonate with eco-conscious customers (Haleem et al., 2022, Kumar et al., 2025). Nonetheless, these possibilities carry responsibilities: AI systems must be built on accurate and representative datasets, and firms are expected to guarantee fairness, accountability, and transparency. Without such safeguards, the promise of AI-driven sustainability could easily be compromised by ethical or societal concerns.

3. Methodology

Colquhoun et al. (2014) argue that a scoping review is beneficial when the aim is to identify central themes, assess the type of evidence available, and locate areas where further research is needed. It enables researchers to map the state of knowledge across various disciplines, spanning healthcare and technology, as well as business and entrepreneurship. In the present study, the review was guided by *Scopus*, which was chosen due to its broad coverage of peer-reviewed publications. The protocol followed the PRISMA-ScR checklist in line with the broader Preferred Reporting Items for Systematic Reviews (PRISMA) standards. Only articles published between 2020 and July 2025 were considered, with a focus on identifying key themes, trends, and contextual developments. According to Lawati et al. (2024) reference management software such as Excel, EndNote, and Mendeley was used both to manage the dataset and to eliminate duplicates. The resulting collection included recent peer-reviewed studies directly linked to the research topic.

3.1 Design

Peters et al. (2015) highlight that scoping reviews are valuable for clarifying concepts, examining variations, considering time factors, and mapping methodological approaches across studies. Similarly, Munn et al. (2018) argue that this type of review enables scholars to explore potential relationships and questions that may later be tested in a systematic review or meta-analysis. In practice, scoping reviews synthesize primary research within a specific area, providing insight into key constructs, assumptions, and contextual dimensions. McGowan et al. (2020) further stressed the importance of applying the PRISMA-ScR framework to improve the rigor, transparency, and accuracy of scoping studies.

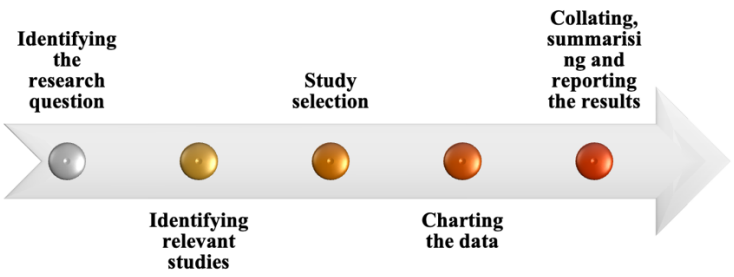


Figure 1: The scoping review process

The results of a scoping review can be represented in multiple formats, including charts, graphs, and statistical summaries, which increase accessibility for readers. In addition, McGowan et al. (2020) underline that presenting findings through structured visuals improves clarity, while (Miller and Colquhoun, 2020) regard PRISMA-ScR as an essential guide for systematically organizing and reporting the outcomes of scoping reviews.

3.2 Eligibility Criteria

Several previous studies have applied similar approaches when refining inclusion and exclusion criteria, ensuring that the final set of articles aligns closely with the research questions, objectives, and search protocol (Peters et al., 2020). This review's scope was limited to research exploring AI and GM published between 2020 and July 2025, with Scopus as the primary databases. A total of 28 studies met the eligibility requirements, encompassing quantitative, qualitative, and mixed-methods designs. The study was conducted in English, a widely understood and accessible language among researchers, as all documents were written in English. Papers from other search engines were excluded because they did not comply with the eligibility criteria. The selected papers were analysed using the data presented in Table 2.

Table 1: The literature's inclusion and exclusion criteria for scoping reviews

Inclusion Criteria	Exclusion Criteria
• Publications examining the concepts of GM and AI • Documents were searched in several nations worldwide. • Title, Abstract, and Keywords were the search parameters used in the database search. • Papers indexed by Scopus	• Documents retrieved using alternative search engines • Research does not address and satisfy research requirements.

3.3 Information Source

Aghaei Chadegani et al. (2013) declared that Scopus is reliable databases used to assess journals based on productivity and citations, evaluating their importance, credibility, and influence. Additionally, Ahmar et al. (2018) asserted that Elsevier encompasses the Scopus database, recognised as the largest abstract repository globally, comprising scientific journals, conference proceedings, and books. It encompasses papers from several topics and contexts, including engineering, social sciences, artistic disciplines, medical studies, and the humanities.

3.4 Search

The research utilized Scopus databases to identify studies on "Artificial Intelligence" and "Green Marketing" across various social, management, and social science disciplines. The keywords were "Artificial Intelligence" and "Green Marketing". The selected documents were filtered and finalized using Endnote, Mendeley, and Microsoft Excel applications to eliminate duplication. Literature included published articles, conference papers, and book chapters. The research focused on the title, abstract, and keywords, considering the topics and areas of study. The references list included references used in the review and supporting information.

Table 3: Search Strategy of Scopus

TITLE-ABS-KEY	Number of Sources – Scopus
TITLE-ABS-KEY "Artificial Intelligence" AND "Green Marketing"	28

Source: Compiled by Authors

3.5 The Choice of Evidence Source

Search phrases such as "AI" and "GM" are used to select relevant research. Forty-four pertinent records were ultimately located using Excel, Mendeley, and EndNote software. Since the objective of this study is teamwork, any disagreements that may arise will be resolved through coordination and discussion among the authors. Additionally, Figure 1 illustrates the scoping review procedure as suggested by (Arksey and O'Malley, 2005) a this process begins with selecting pertinent studies and research topics, then proceeds to study selection and data charting. The final step involves gathering, compiling, and reporting the findings.

4. Results

Additionally, the qualifying requirements dictated the methodology for evaluating the databases' keywords, abstracts, and titles. In total, 28 publications were selected for analysis, with a focus on research objectives and questions serving as the foundation for the analysis of the results. The following graphic shows the primary keywords from the Scopus search databases.

4.1 Publication Trend

The patterns of published articles by year of publication, as discussed in RQ2, are shown in Figure 1. There are an increasing number of publications in this specific field of study every year. The most recent study, conducted in 2025, resulted in 14 published documents, while the oldest studies, conducted in 2020, produced only one publication, indicating that this is a relatively new area of study.

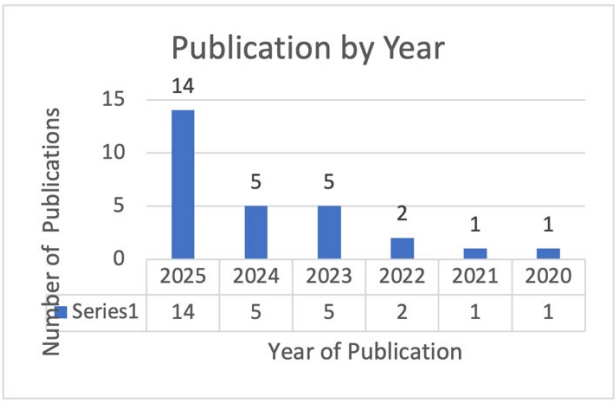


Figure 2: The trend of published studies

4.2 Publication Source

Figure 2 illustrates the examination of the selected articles in relation to their publishing sources, addressing RQ3. The highest publication was by the Lecture Notes in Business Information Processing, with 3 publications, followed by other sources with 1-2 publications. Especially, among the examined research, conference papers exceeded articles regarding publication type, followed by "Cleaner and Responsible Consumption" and "Springer Proceedings in Business and Economics", and the rest had only 1 publication. As most of the document's type were as conference papers with total of 8 publications.

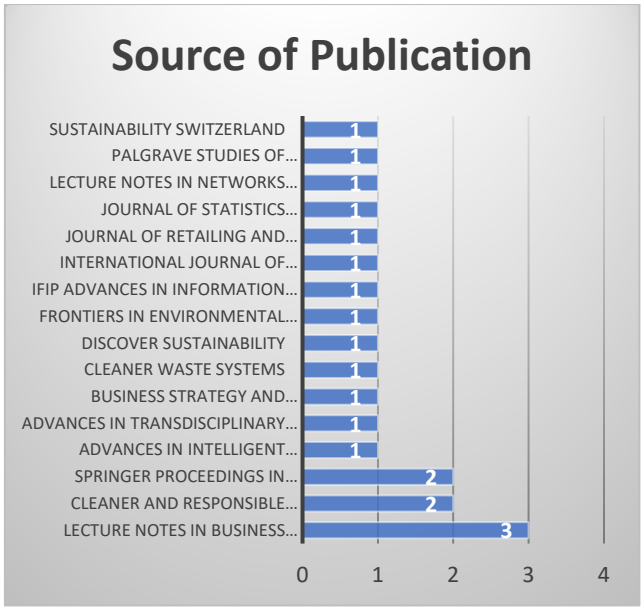


Figure 3: Article distribution based on the publication source

4.3 Context Analysis

Emphasizing the context aspect, the majority of research—28 publications—was conducted in the highest countries, starting with India (5), followed by the United Arab Emirates (3), and the remaining nations with 1 publication each, as shown in Figure 3, which answers RQ4. This demonstrates how Asian nations encourage greater research into the elements of digital leadership, innovation, and culture, particularly through the publications of higher education institutions.

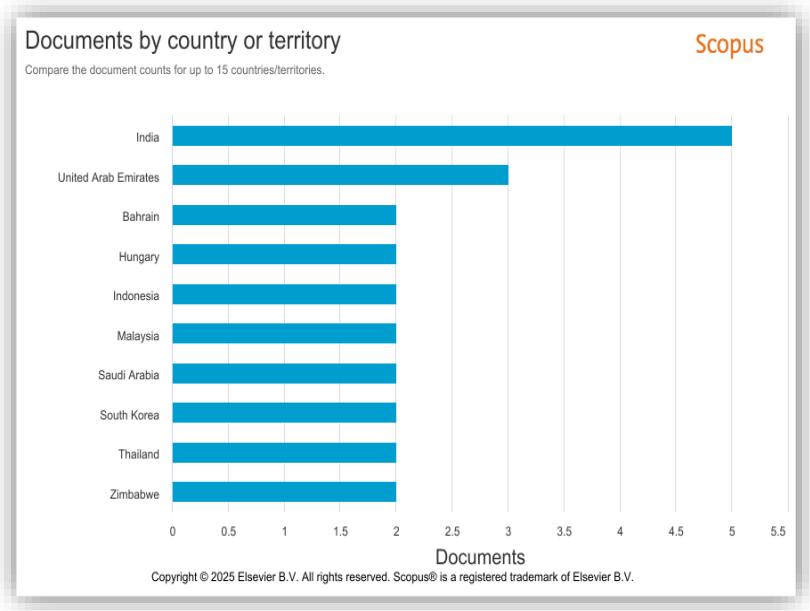


Figure 4: Country of Research

5. Discussion

The objective of this scoping review was to map the body of research on the application of AI to enhance sustainability. The review provided sufficient evidence regarding the influence of daily life, the capacity to offer novel insights, the redefinition of research boundaries, and energy-conscious consumption. This outcome broadens the topics that businesses should focus on if they want to keep investigating the future of green marketing. Furthermore, by incorporating AI into the green marketing forecast, the study suggests that

businesses can uncover the aspirations of numerous potential clients and leverage the collective purchasing patterns of contemporary consumers. The study aimed to investigate how these insights could benefit AI across a wide range of fields, particularly in the context of interdisciplinary research, with a focus on green marketing. There is room for incorporating different aspects, such as digital customer experience, blockchain, generative AI, Agentic AI, sustainability practices, green advertising, social Media platforms, the internet of things (IoT), and circular and green economy, into green marketing and AI, while examining various sectors and fields along with AI and green marketing.

The rescaling of artificial intelligence has constraints, considering that every concept has its limitations. When it comes to anticipating AI data for use in green marketing applications, it could be stated that the population is the most important resource. Organisations undergoing an AI transformation might not be familiar with effective green marketing techniques, but this will soon be resolved with the use of social aptitude insights and AI data analysis tools, as AI offers new avenues for meeting social demands. This study has several knowledge suggestions for researchers. There are still significant obstacles to overcome when utilizing AI to construct green marketing strategies at the daily company level, such as data retrieval, mining, analytics, and environmental knowledge development. However, if individuals utilize more AI to forecast the opening of various shops and the output of cultivation or trading, the answer brought to safe dedication would increase if the marketing capability or prediction of green market insight is stable and dependable. This is the ethical debate surrounding how to earn the trust of people, or AI in general. All of these might be more limitations than insights into the complex and contentious topic of emotion or judgment. They do not supersede the current state of the art and are not absolute. In the real world, the results of this study can be applied to develop a comprehensive and effective green marketing plan. These results enable us to focus on the elements of AI in green marketing that are worth considering for our business objectives. The findings of this study could be highly beneficial in several ways, particularly in relation to green marketing tactics, given the implications of current AI research.

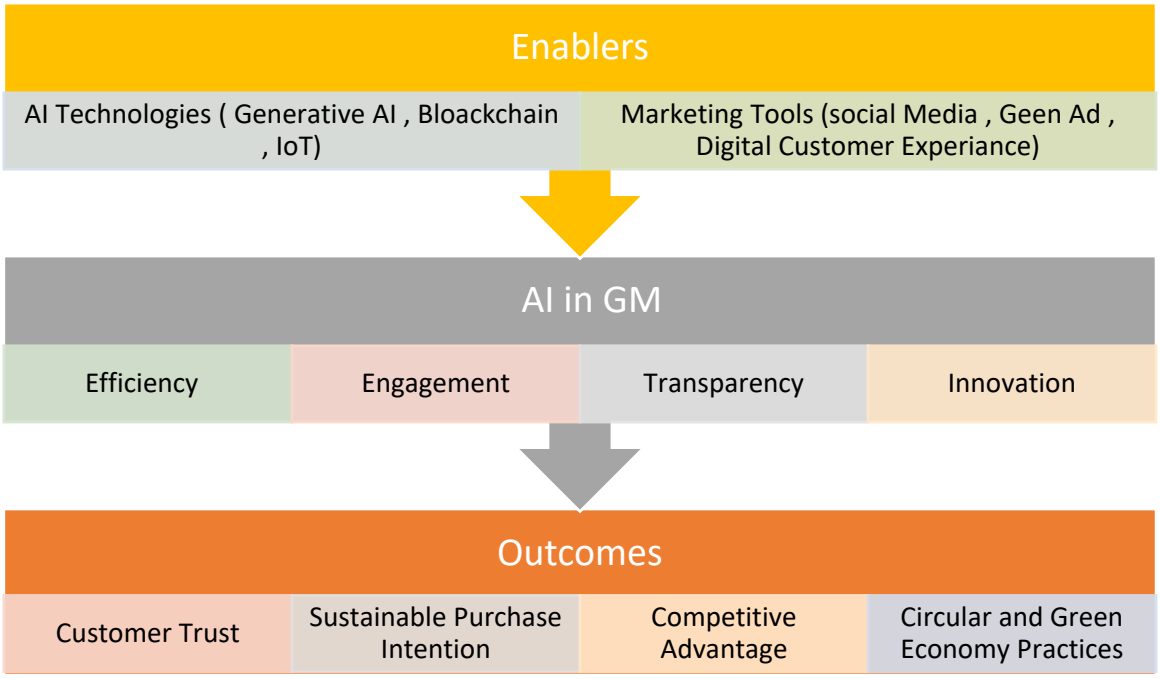


Figure 5: Model of the study

Figure 5 illustrates the conceptual model of the study. The conceptual model presents a coherent framework that connects enablers, processes, and outcomes in AI-enhanced green marketing. The process begins with technological facilitators (e.g., generative AI, blockchain, IoT) and marketing facilitators (e.g., social media, digital customer experience, sustainable advertising), which create the necessary conditions for adoption. These enablers contribute to the process layer, where AI applications enhance operational efficiency, increase consumer involvement, ensure transparency in environmental claims, and promote sustainability-focused innovation. The method yields quantifiable results: at the consumer level (trust and sustainable purchasing intentions), at the organizational level (competitive advantage and enhanced CSR positioning), and at the society level (promoting circular and green economy practices). The model illustrates a sequential logic where enabling

variables propel processes that subsequently provide outcomes, establishing AI as both the catalyst and enhancer of sustainable marketing change.

6. Conclusion

The basis of green marketing is to make, promote, and sell products that are sustainable and eco-friendly. The increasing interest in green marketing, driven by human activities that have been largely uncaring, has become the main driving force behind the rise in demand for and use of artificial intelligence in green marketing. Artificial intelligence contributes to the growth and success of businesses in many ways, including the introduction to diverse marketing strategies, analysis of valuable and relevant data about government regulations and policies, and assistance in optimizing environmental sustainability. To date, several studies have focused on the role of AI in green marketing. However, these studies are usually sector-specific, without providing access to the general application of AI. Furthermore, there is no specific guidance on establishing the general pathway for AI and green marketing. As a result, there is a need to investigate the diverse range of AI applications in this domain. The purpose of this study is to undertake green marketing using three scholarly areas: marketing theory, environmental research, and AI. These societal implications amplify the positive impact of green marketing techniques by promoting environmental friendliness. Meanwhile, the study explained the effects of applying AI to green marketing.

The review identifies potential avenues for future research on marketing and AI in green marketing, emphasizing cross-disciplinary convergence and the design of management and prediction/forecasting systems. The long-term impact of AI on green marketing will prompt new consumer behaviours and attitudes, requiring further development. Expanding the review and providing concrete research propositions is crucial. Newer research testing consumer reactions to AI regulation and principles is needed to develop sensitive perceptions of patient-integrated services. The growing interconnectedness of AI in marketing raises concerns about environmental and ethical issues, underscoring the need for a deeper understanding of potential long-term consequences.

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Ethics and AI Declaration

This study did not require ethical approval. AI tools were used if needed only for grammar and readability.

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Academic Entrepreneurship: Challenges and Opportunities of the Poliempreende Program

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Abstract: This study examines the effect of the Poliempreende program on the development of transversal and entrepreneurial skills among students at the Polytechnic University of Cávado and Ave, as well as its role in enhancing employability and fostering professional networking opportunities. The research stems from the need to assess Poliempreende's contribution to strengthening the entrepreneurial culture, bridging the gap between academia and industry. The main objectives are: i) to analyze the impact of Poliempreende on the development of transversal and entrepreneurial skills, ii) to explore the dynamics between academia and industry, and iii) to evaluate the challenges and opportunities of this program within the IPCA context. To accomplish these goals, a survey has been created and answered by the finalists of the last four editions of Poliempreende. The results provide evidence on the impact that Poliempreende had on the development of skills such as leadership, resilience, communication, and innovation capacity. It also backed up the participants' employability, and it has also facilitated access to professional networking opportunities. Furthermore, the program's structured framework, which combines workshops, mentoring, and competitions, has proven to be valuable in preparing participants for real-world challenges. Although, despite its positive impact, the program would have benefited from a more structured post-competition support, which could have been provided by an incubator, to consolidate the project outcomes and ensure business continuity. The findings underscore the potential for higher education institutions to drive regional development and economic growth through initiatives like Poliempreende.

Keywords: Poliempreende, Entrepreneurial skills, Transversal skills, HEIS Third Mission, Higher Education.

1. Introduction

Entrepreneurship has become an area of growing relevance in the academic context, standing out for its potential to increase innovation and economic development. Audretsch and Thurik (1999) point out that entrepreneurship is a driving force behind the creation of new opportunities and jobs, representing an effective response to changes in the global market. In this sense, this paper focuses on the study of academic entrepreneurship, with special emphasis on the Poliempreende program, developed at the Polytechnic University of Cávado and Ave (IPCA).

The choice of this issue arises from the need to better understand the role of higher education institutions in transferring knowledge and promoting entrepreneurial skills among students and the academic community. The Poliempreende program, as an entrepreneurship support platform, has proven to be a fundamental asset for bringing closer academia and industrial organizations, encouraging and giving rise to the creation of new innovative companies (Lopes *et al*., 2021).

The main general objectives of this study are i) to analyze the impact of Poliempreende on the development of transversal and entrepreneurial skills, ii) to investigate the dynamics between academia and industry, and iii) to evaluate the challenges and opportunities of this program in the context of IPCA.

The methodology adopted is a quantitative, using a survey to inquire about the finalists of the last 4 editions of Poliempreende held at IPCA, i.e., participants who have completed the entrepreneurial process and presented the final pitch. The data was analyzed using descriptive statistics.

The paper is organized into two parts. The first part presents the literature review on academic entrepreneurship, the role of Higher Education Institutions, and the Industry/Academia relationship. The second part presents the methodology and the case study, namely, the analysis of the survey and the respective discussion of results; finally, the conclusions are presented.

2. Academic Entrepreneurship

Academic entrepreneurship plays a central role in the application of knowledge and technology, facilitating the transfer of innovations from research institutions to the market. It includes the transformation of scientific discoveries into economic and social value through formal mechanisms such as spin-offs, patents, and licensing, as well as informal practices like consultancy and collaboration with industry (Balven et al., 2018).

Balven et al. (2018) describe academic entrepreneurship as the intersection between academia and the business sector, where knowledge is transformed into products, services, or companies that generate economic and social value. This view reinforces the importance of structured support mechanisms, such as incubators and partnerships, to bring laboratory innovations to market.

More recently, Giunti and Duberley (2023) emphasize that academic entrepreneurship is a core element of the "third mission" of higher education institutions, alongside teaching and research. They highlight that entrepreneurship activities should not only be market-driven but also aligned with the institution's responsibility to create social value. In this context, Sieg et al. (2023) argue that academic entrepreneurship must incorporate sustainability principles to ensure long-term impact. Innovations should not merely respond to market opportunities but also promote eco-innovation and contribute to sustainable development.

In parallel, the role of entrepreneurial education has gained prominence as a catalyst for academic entrepreneurship. Entrepreneurial education contributes to the development of essential competencies such as decision-making, risk management, and self-confidence, while also preparing students for the practical challenges of creating new ventures (Ramos et al., 2020). Initiatives that combine theory with practice, such as startup internships, mentoring, and incubation, offer students a more realistic understanding of the entrepreneurial process, enhancing their capacity to translate knowledge into viable business models (Ramos et al., 2020; Lopes et al., 2021). Furthermore, the development of soft skills, such as creativity, leadership, and teamwork, is increasingly recognized as fundamental for fostering innovative environments in which students can transform ideas into value-generating enterprises (Lopes et al., 2021).

According to Conceição and Rodrigues (2021), academic spin-offs are among the most tangible outcomes of academic entrepreneurship, as they represent a structured channel for transforming university-based research into marketable products or services. These ventures also reflect the growing role of higher education institutions as active contributors to regional economic and social development, going beyond their traditional missions of teaching and research.

Moreover, Conceição and Rodrigues (2021) highlight that motivations among academic entrepreneurs often diverge from purely profit-driven logic. Many founders prioritize knowledge dissemination, societal contribution, or long-term project sustainability over immediate commercial success. They also emphasize that the entrepreneurial process within academia is shaped by a set of critical stages, including opportunity recognition, commitment, credibility building, and pursuit of sustainability, each of which presents its own set of challenges.

Importantly, they argue that adverse economic conditions, such as financial crises, do not necessarily inhibit academic entrepreneurship. On the contrary, necessity-driven entrepreneurship can emerge as an alternative for researchers and graduates facing limited labour market opportunities, suggesting that spin-off creation may even increase during downturns.

Finally, the authors underline that several institutional and contextual factors condition the success of academic spin-offs, such as access to infrastructure, support from the parent university, and collaboration with external partners. Therefore, the presence of a supportive ecosystem remains a crucial enabler for the effective implementation of academic entrepreneurship.

Despite the promising outlook, several authors highlight persistent barriers. Testas and Moreira (2014) point to the limited diffusion of entrepreneurial practices across academic disciplines, particularly outside business schools, underscoring the need for systemic reforms that embed entrepreneurship education more broadly in higher education curricula. Similarly, Lopes et al. (2021) identify bureaucratic constraints and a lack of practical experience among students as challenges that hinder the full implementation of academic entrepreneurship. These critical perspectives suggest that while academic entrepreneurship holds significant transformative potential, its success depends on coherent institutional strategies, cross-disciplinary integration, and supportive ecosystems.

3. Higher Education Institutions and the Third Mission

Since the early 19th century, with the emergence of the Humboldtian model that integrated research and teaching, Higher Education Institutions (HEIs) have undergone multiple transformations (Schnurbus & Edvardsson, 2020). A third institutional mission, focused on societal engagement and regional development, has been gaining increasing prominence alongside the traditional missions of teaching and research (Chatterton & Goddard, 2000).

Chatterton and Goddard (2000) were among the first to frame this "third mission" as the incorporation of entrepreneurial activities aimed at generating not only economic value but also public and social value through knowledge and technology transfer. This idea reflects a growing recognition of the societal responsibilities of HEIs.

The literature has since expanded to differentiate the nature of third mission activities. According to Donatiello and Gherardini (2019), these can be classified into profit-oriented and non-profit-oriented actions. The former includes formal and informal industry collaborations, academic consulting, patenting, and the commercialization of research through spin-offs. The latter involves public policy contributions, entrepreneurial education, and social outreach, such as lifelong learning and partnerships with vocational institutions (Cervantes, 2017).

Schnurbus and Edvardsson (2020) argue that HEIs have reached another inflection point, driven by globalization, financial market instability, and increasing competition for funding and talent. These external pressures have catalyzed a redefinition of institutional missions, leading to greater emphasis on internationalization and entrepreneurship. However, this evolution has not been seamless. While policies increasingly promote third mission activities, their institutionalization remains fragmented and uneven.

A critical perspective is offered by Calderón-Hernández et al. (2020), whose empirical research reveals tensions within academia regarding the role of knowledge. On one hand, some view it as a public good; on the other, others see it as proprietary and commodifiable. The authors highlight that rejecting the third mission, especially its emphasis on applied knowledge and societal impact, risks rendering HEIs isolated from the communities they serve. This detachment is exacerbated by the prevalence of academic outputs that are inaccessible to the general public, both in language and in utility.

Compagnucci and Spigarelli (2020) expand on this critique by emphasizing that the third mission should not be seen as an auxiliary function, but rather as a structural component of HEIs. They underline its potential to foster regional development through collaboration with non-academic stakeholders, such as governments, industries, and civil society. Yet, they also identify systemic constraints, including the tendency of institutions to imitate elite, research-intensive models, which can lead to detachment from local needs. Furthermore, the lack of incentives, resources, and recognition for third mission activities undermines their implementation. The multidisciplinarity and context-dependence of these activities only add to the complexity.

Finally, Muffatto et al. (2021) examine the entrepreneurial implications of the third mission. They argue that third mission activities enrich academic environments and ensure that research is aligned with real-world challenges. Their findings also suggest that HEIs that foster entrepreneurship through mechanisms such as incubators and mentoring programs stimulate both regional economic growth and researcher motivation. Importantly, the authors point out that institutional environments valuing practical knowledge application are more likely to see the emergence of academic entrepreneurs and the formation of innovative ventures. They advocate for policies that support intellectual property protection, spin-off creation, and long-term industry collaboration.

In summary, the literature on the third mission highlights both its transformative potential and its practical challenges. While the third mission is increasingly acknowledged as vital for aligning HEIs with societal needs, its integration into academic structures is still limited. The field would benefit from more critical, theory-driven research that addresses power dynamics, institutional inertia, and normative assumptions underpinning third mission discourse.

4. Methodology

To understand the role of higher education institutions in transferring knowledge and promoting entrepreneurial skills among students and the academic community, a case study of the Poliempreende program at the Polytechnic University of Cávado and Ave (IPCA) was carried out. The main general objectives of this study are i) to analyze the impact of Poliempreende on the development of transversal and entrepreneurial skills, ii)

to investigate the dynamics between academia and industry, and iii) to evaluate the challenges and opportunities of this program in the context of IPCA.

The methodology adopted a quantitative approach with data collected through an online survey (Google Forms) to be answered by participants of the last four editions of Poliempreende at IPCA. Considering the objectives of the study, only participants who reached the end of the entrepreneurial process were considered, i.e., participants who presented the final pitch to the Poliempreende jury, a total of 64 participants.

In terms of data collection, for the 2024 edition of Poliempreende, questionnaires were collected in person on the day of the final (10 July 2024), directly from participants presenting their projects. For previous editions (2021 to 2023), data were gathered between July and October of 2024, using a combination of methods: via the G3E platform, through email distribution, and direct personal contact with known participants from those editions. Of these 64 participants, 34 answered the survey, corresponding to a response rate of 53%.

In this study, the survey used consisted of four sections. The first section asks about sociodemographic data, followed by three sections, each associated with the three main objectives of the study, namely: section 1 - Transversal skills; section 2 - Entrepreneurial Skills; and section 3 - Perceived Employability.

5. Case Study: Poliempreende

Poliempreende is an annual entrepreneurship competition promoted by Polytechnic Higher Education Institutions to encourage the creation of innovative and sustainable businesses and promote an entrepreneurial mindset in academia. Aimed at students, graduates, and teachers, the program includes workshops, training sessions, and regional and national competitions, where business ideas are assessed according to criteria such as innovation, sustainability, and socio-economic impact. The best ideas receive prizes and support in their implementation (Poliempreende, 2024; Parreira *et al*., 2018).

Started in 2003 by the Castelo Branco Polytechnic University, it expanded nationally in 2007, with rotating coordination. Over the years, it has stood out for its technology transfer and regional development, creating 32 companies and registering 59 patents. With more than 1,800 participants, Poliempreende has had a relevant impact on the growth of entrepreneurship in Portugal (Parreira *et al*., 2011; Parreira *et al*., 2018).

Poliempreende plays a strategic role in strengthening the link between HEIs and the job market, creating an environment in which academic knowledge is put into practical use. As well as promoting the creation of companies, the program also contributes to regional development by supporting initiatives aligned with local and global needs (Parreira *et al*., 2011; Parreira *et al*., 2018).

Through workshops focused on entrepreneurial skills and a structured competition, participants have access to specialized training and personalized mentoring, thereby increasing their chances of successfully implementing their business ideas. This model not only promotes innovation but also consolidates the role of HEIs as agents of social and economic transformation (Poliempreende, 2024; Parreira *et al*., 2018).

Poliempreende goes beyond the confines of the academic world, bringing innovation and development to local communities. By encouraging the creation of companies and promoting technology transfer, the program contributes directly to the economic development of the regions where it takes place, being an example of how higher education can actively collaborate in socio-economic growth (Parreira *et al*., 2018).

The program also has an international dimension, with the cooperation of institutions such as the Macao Polytechnic Institute and organizations in Cape Verde, reflecting its commitment to preparing students for the global market (Parreira *et al*., 2018).

Poliempreende has faced challenges over the years, such as securing continuous funding and maintaining institutions' interest in the program. Despite these challenges, the program continues to grow and expand its influence (Parreira *et al*., 2018). In the future, the goals that are expected to be achieved include expanding the program to all Polytechnic Universities to ensure the participation of all institutions and increasing the reach of students from all polytechnic areas. In addition, it is intended to continue internationalization, in line with the best global practices in entrepreneurship and innovation. Finally, it is seen as necessary to create support structures in all institutions, guaranteeing formal resources for the development of entrepreneurial projects and strengthening support for entrepreneurship within the scope of the program (Poliempreende, 2024).

6. Results

This study analyzed four editions of the Poliempreende program, covering the years 2021 to 2024. In the four years analyzed, 64 people completed the entrepreneurial process, i.e., presented the final pitch for their project. Of these 64 people, 34 answered the survey, corresponding to a response rate of 53%. Analysis of this sample provides a better understanding of the results and effectiveness of Poliempreende in the context of the Polytechnic University of Cávado and Ave (IPCA).

6.1 Sociodemographic Data

Among the 34 respondents, there was a balanced gender distribution, with 53% female and 47% male. Concerning educational background, 53% of respondents have a bachelor's degree, 26% have secondary education, 14.71% have completed a master's degree, and 2.94% have a PhD. Educational diversity reflects that the program attracts participants with different levels of qualification. The educational diversity seen demonstrates the transversal interest in the program, ranging from young people who are still progressing in their studies to more qualified professionals looking for new skills.

In terms of employment status, the respondents are equally distributed between students (29.41%), employees (29.41%), and student-workers (29.41%). Only 11.76% are self-employed. This profile shows the flexibility of the program, which welcomes both participants at the start of their careers and those already in the job market. The balanced representation of the different job profiles reflects Poliempreende flexibility in attracting both those who are starting and those who already have experience in the market. This allows for a diverse environment rich in exchanges of experience.

Geographically, most participants come from Barcelos (32.35%) and Braga (29.41%), with less representation from other regions. This geographical concentration reflects the demographic profile of IPCA students. As for the schools of origin, the participation of the School of Technology (29.41%) and the School of Management (23.53%) stand out, showing greater interest in areas related to technology and business. The greater representation of these schools may indicate that the knowledge and skills worked on at Poliempreende have a direct and practical link with the more technical and market-oriented areas of study.

6.2 Experience as an Entrepreneur

Among the respondents, 53% have previous entrepreneurial experience, while 47% are just starting on their entrepreneurial journey. Similarly, 53% of the participants had experience in the business idea they developed in the program, while 47% had no such experience. These figures indicate that Poliempreende is relevant to both beginners and more experienced entrepreneurs. These figures reflect the versatility of Poliempreende, which manages to be a useful program for both those who already have entrepreneurial experience and those who are taking their first steps, providing a learning environment that is adaptable to different levels of experience.

6.3 Transversal Skills Acquired

The participants who responded perceived that they developed various transversal skills during the program. The most prominent were communication (70.59%), teamwork (67.65%), and problem-solving (64.71%), all of which are essential for success in entrepreneurial environments. These results show that the program not only focuses on technical skills, but also on interpersonal skills, which are essential in any professional context.

These skills have practical application, especially in professional and personal contexts (88.24%). Personal projects (61.76%) and academic activities (50%) were also identified as areas of application by the respondents. The wide applicability of the skills demonstrates that Poliempreende not only prepares participants for business creation scenarios, but also for a variety of practical situations in the job market and academic life.

The training received at Poliempreende is perceived as relevant to the job market, with almost all participants (91.18%) considering the skills acquired to be "very" or "quite" important, resulting in an average score of 4.35 on a Likert scale of 1 to 5. This data reinforces the program's ability to provide its participants with tools that are valued in the job market.

6.4 Developing Entrepreneurial Skills

Poliempreende contributes to the development of an entrepreneurial mindset. Networking stood out as the most developed skill (67.65%), followed by communication (61.76%), leadership (58.82%), and financial

knowledge (58.82%). These skills are often cited as fundamental pillars for building sustainable businesses and adapting to dynamic and collaborative working environments.

The competition encouraged 82.36% of respondents to look for business opportunities, with 82.35% planning to apply the entrepreneurial principles learned in their professional lives. These results show that the program stimulates innovation, creativity, and the ability to identify opportunities. In addition, the competition acted as a catalyst for innovation and creativity, helping participants to think "outside the box" and identify strategic solutions.

6.5 Impact on Employability

Most respondents (91.18%) believe that Poliempreende has improved or will improve their employability prospects, which reinforces Poliempreende positive impact on preparing participants for the labor market. This is especially relevant as it shows that the program not only develops skills but also increases participants' confidence in their abilities and future opportunities.

The entrepreneurial process was also considered "very" or "quite" effective in creating networking relationships and developing transversal skills, with respective averages of 4.24 and 4.32 on a Likert scale of 1 to 5. This recognition reflects Poliempreende ability to create value at both an individual and collective level, encouraging participants to create networks and collaborations that could be essential in the future.

Additionally, 88% of respondents expressed their intention to continue working on the business idea developed during the program, showing the lasting impact of Poliempreende on the motivation and ambition of its participants. This shows that the program not only promotes short-term learning but also has a long-lasting effect on the entrepreneurial attitude of its participants, encouraging them to continue developing their projects.

7. Discussion of Results

The analysis of the results obtained from the survey reveals important perceptions about the impact of Poliempreende on skills development, academic-industry collaboration, and the opportunities and challenges of the program in the context of the Polytechnic University of Cávado and Ave.

7.1 Development of Transversal Skills

One of the main objectives of the research was to assess how Poliempreende contributes to the development of transversal skills among the participants.

Leadership was one of the skills most mentioned by the participants (58.82%), who found themselves needing to organize teams, make strategic decisions, and motivate colleagues. The requirement to work as a team to achieve common goals provided a business simulation environment that enhanced these skills, creating a space conducive to practical experience, which, according to Spencer and Spencer (1993), is essential for the growth of effective leaders. This result reinforces the importance of behavioral and strategic skills for developing an entrepreneurial vision, according to Guerrero et al. (2021).

In addition, 24 of the 34 participants (70.59%) reported a significant increase in their communication skills. The practical experience of preparing and presenting pitches in front of juries made up of professionals was highlighted as a moment of personal transformation, where participants not only gained confidence but also learned how to structure and communicate their ideas persuasively. Clarity and effectiveness in conveying ideas, a critical aspect for success in any field, as emphasized by Spencer and Spencer (1993).

7.2 Developing Entrepreneurial Skills

The results of the questionnaires showed that Poliempreende was effective in developing entrepreneurial skills among the participants, a key dimension of the study. During the competition, 67.65% of respondents reported that they were able to improve their networking as one of the main skills developed. This process involved not only creating new connections but also teaching participants the importance of maintaining professional relationships, something that can have a direct impact on their future entrepreneurial activities.

In addition, 61.76% pointed to improvements in their communication skills, while 58.82% highlighted the development of leadership and financial knowledge. Financial knowledge was described as one of the pillars

that enabled participants to better understand the economic viability of their business ideas, contributing to a more strategic vision of business planning and execution.

These results show that participation in Poliempreende encourages not only the creation of innovative ideas but also the formation of a solid base of skills for the business environment, as described by (Pallavi et al., 2022).

7.3 Employability and Networking

One of the main impacts of Poliempreende in the perception of the participants is the improvement of their employability prospects and the expansion of their professional networks, essential factors for a successful transition to the labor market. The majority of participants, around 93.9%, reported that the Poliempreende experience increased their attractiveness on the labor market. This figure is particularly relevant, as it indicates that the program not only develops specific skills but also reinforces the perception of participants as more complete professionals prepared for modern challenges.

The program demonstrates that they are proactive individuals capable of innovation. This perception is in line with the study by Pallavi *et al*. (2022), which highlights the role of entrepreneurship in creating social and economic value by training individuals for the job market. In addition, Poliempreende helped to consolidate skills that go beyond technical knowledge, such as the ability to adapt and resilience, characteristics that are often valued by employers in highly competitive scenarios.

Participation in Poliempreende gave 91.2% of the participants access to a diverse network of professionals, mentors, and potential investors, which they recognized as one of the main benefits of the program. According to Guerrero *et al*. (2021), networks have a lasting impact on an entrepreneur's career, as they provide access to knowledge, resources and opportunities. In the context of Poliempreende, these networks not only opened doors to future partnerships and investments but also allowed participants to get valuable feedback on their projects, increasing their chances of success.

8. Conclusions

The main objective of this research was to analyze the impact of the Poliempreende program on the development of transversal and entrepreneurial skills among students at the Polytechnic University of Cávado and Ave (IPCA), as well as its role in promoting employability and creating professional networks. Specifically, we sought to understand the program's contribution to promoting an entrepreneurial culture in the academic context, while assessing the challenges and opportunities associated with the program in regional and academic development.

To meet these objectives, a case study was carried out on Poliempreende at IPCA, using a quantitative methodological approach. A survey was answered by finalists of the last four editions of the program (2021, 2022, 2023, and 2024).

The conclusions of this study on the impact of Poliempreende at IPCA confirm the importance of the program as an essential tool for developing skills and promoting academic entrepreneurship. The program has fulfilled its role in instilling an entrepreneurial culture, offering students an environment where they can acquire and apply practical knowledge and develop critical skills for the labor market.

In terms of contributions to skills development, the results confirm that Poliempreende contributes to the development of transversal and entrepreneurial skills, such as leadership, critical thinking, and resilience, in line with the literature on the importance of these skills in the modern workplace (Carvalho, 2022; Pallavi *et al*., 2022). The program proved to be effective in empowering students with practical tools that strengthen their ability to adapt and innovate, essential characteristics for entering the labor market.

This study also highlights the need for higher education institutions to play an active role in the growth of academic entrepreneurship, recognizing them as strategic agents in the training of professionals prepared for the challenges of the labor market. This reinforces the importance of boosting programs such as Poliempreende, not only as a platform for developing skills, but also as a key element in promoting innovation, self-employment, and regional economic impact. Although some challenges and obstacles need to be overcome, such as the need for greater post-competition support and the implementation of an incubator, which has since been approved, the opportunities for strengthening the program are promising.

In short, the study highlights the importance of Poliempreende as a catalyst for the development of entrepreneurial skills in IPCA students, highlighting its role in promoting an entrepreneurial culture and creating a connection between academia and industry.

In this study, there were also constraints in obtaining responses to the survey - the response rate is close to 50%, largely because the participants from more distant editions in time, such as 2021 and 2022, are already disconnected from Poliempreende and there weren't as many responses as possible from these students. This study also did not carry out an advanced statistical study of the survey responses due to a lack of time and resources.

In terms of future expectations, this work has the possibility of being updated annually due to the fact that Poliempreende at IPCA takes place every year, so the data from the survey can be updated annually. With this update and a greater amount of data, policy implications can be drawn for HEIs and their Entrepreneurship support offices.

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Ethics Declaration

This study did not require ethical clearance for the research referred to in this paper.

AI Declaration

No AI tools were used in the development of this paper.

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Charting the Future of Entrepreneurial Orientation: A Systematic Review and Science Mapping of Generative AI's Emerging Impact

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Abstract: This working paper aims to provide a comprehensive overview of how Generative Artificial Intelligence (GenAI) is shaping the evolution of Entrepreneurial Orientation (EO), understood as a strategic construct including innovativeness, proactiveness, and risk-taking. As GenAI tools become increasingly accessible and applied, their effects on entrepreneurial behavior and decisions are gaining attention. However, there is still not a clearly defined picture of the conceptual and empirical relationship between these two domains. To address this gap, a systematic review of literature has been conducted using PRISMA guidelines, across the databases of Scopus and Web of Science, collecting peer-reviewed articles between 2019 to 2025. Documents were identified, screened and evaluated, following criteria such as theoretical consistency and methodological relevance. In parallel, a science mapping approach was used, including co-occurrence of keywords, co-citation networks, and thematic clusters, with the goal to visualize the structure and growth of research. The results shows five main clusters: first, GenAI contributes to better performance by aligning well with entrepreneurial tasks; second, it enhances innovation and decision-making under uncertainty; third, it supports both generative and acquisitive learning in entrepreneurial contexts; fourth, it enables sustainability-oriented entrepreneurship by affecting how entrepreneurs perceive desirability and feasibility; and finally, GenAI plays a mediating role in product customization and market performance. Yet, there are challenges still to overcome ethical concerns, data bias and the lack of digital competencies among entrepreneurs. In conclusion, the paper recommends more studies that can go beyond correlation, including longitudinal designs or experimental methods, to better understand causal mechanisms. Also, some attention should be paid to the role of GenAI in entrepreneurial education, since many universities are still catching up with these fast technological transformations. Why is your paper of interest to the conference participants? Use this space to persuade the reviewers why they should select this abstract for the conference: This paper offers timely insight into how GenAI is reshaping entrepreneurial behavior, strategy, and education. It bridges technology and entrepreneurship through rigorous analysis and visualization, making it highly relevant for scholars, educators, and practitioners seeking to understand emerging trends and future capabilities in entrepreneurial ecosystems.

Keywords: Entrepreneurial Orientation, Generative Artificial Intelligence, Strategic Decision-Making, Systematic Review and Entrepreneurial Ecosystems

1. Introduction

The rapid development of artificial intelligence (AI) has transformed how firms compete, innovate, and create value across industries, opening unprecedented opportunities for entrepreneurship (Zulfiqar et al., 2025). Among its most disruptive advancements, generative AI (GenAI) produces ideas, content, and solutions that enhance productivity while redefining strategic choices and market positioning (Dabić et al., 2023; Rajaram & Tinguely, 2024). For entrepreneurs, GenAI represents both opportunities and challenges: it fosters creativity, reduces uncertainty, and supports decision-making, but also raises concerns about ethics, governance, and digital skills (Wach et al., 2023; Wirth et al., 2025). Entrepreneurial orientation (EO), defined by innovativeness, proactiveness, and risk-taking, provides a useful lens for understanding these dynamics (Davidsson & Sufyan, 2023). GenAI enhances EO by enabling innovative solutions (Xu et al., 2024), supporting proactivity with predictive analytics (Ahmić & Šahović, 2025), and facilitating risk-taking by reducing uncertainty (López-Solís et al., 2025). Yet, the literature remains fragmented, requiring systematic synthesis (Dwivedi, 2025).

2. Methodology

This study conducted a systematic literature review consistent with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and replicability (Moher et al., 2009). Two comprehensive databases, **Scopus and Web of Science**, were selected for their wide coverage of peer-reviewed journals in business, technology, and social sciences (Mongeon & Paul-Hus, 2016). The search was limited to English-language articles published between **2019 and 2025**, reflecting the rise of generative AI (GenAI) and its implications for entrepreneurial orientation (EO). A Boolean query combined four domains: ("generative artificial intelligence" OR "artificial intelligence") AND ("entrepreneurial orientation" OR "entrepreneurship" OR "entrepreneur" OR "business strategy") AND ("innovation" OR "creativity" OR "startups") AND ("decision

making" OR "risk taking" OR "proactiveness" OR "autonomy"). The search yielded **120 documents**, of which 37 met the inclusion criteria after screening and full-text evaluation.

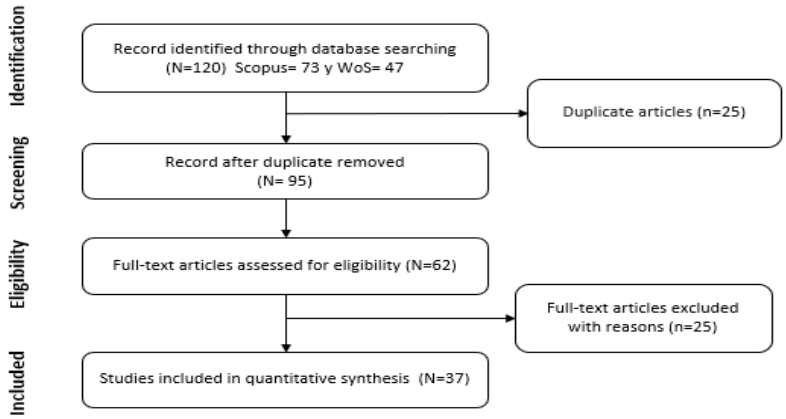


Figure 1: PRISMA Flow Diagram

3. Findings

The synthesis of the reviewed literature highlights diverse ways in which GenAI influences Entrepreneurial Orientation (EO). Key findings reveal its impact on innovation, adoption in startups, education, sustainability, and ethical considerations. The main themes, insights, and representative references are summarized **as shown in Table 1**, providing a structured overview of this evolving research domain.

Table 1: Key Findings on the Relationship Between Generative AI and Entrepreneurial Orientation

Theme	Key Insights	References
Increased Publication and Research Focus	Significant surge in publications on AI and entrepreneurship, with annual growth rate above 32%, reflecting rising interest and recognition of AI's role in entrepreneurial contexts.	Alqahtani & Alqahtani (2024)
Impact on Innovation and Business Models	GenAI identified as an engine of industrial innovation, transforming processes, models, and value propositions. Examples include operational, product, and business model innovation, with expected ROI of 10% by 2025.	Xue & Jiang (2025); Sedkaoui & Benaichouba (2024); Marshall et al. (2024)
Adoption and Utilization in Startups	Startups and SMEs leverage GenAI for competitive advantage, digital transformation, and new business models. Adoption influenced by social influence, domain experience, technology familiarity, and system quality.	Gupta (2024)
Ethical and Responsible AI Development	Emphasis on ethical frameworks to address bias, privacy, and accountability concerns, ensuring responsible and equitable adoption of GenAI.	Sedkaoui & Benaichouba (2024);
Sustainability and Entrepreneurial Intentions	GenAI enhances sustainability-oriented entrepreneurial intentions via psychological mechanisms.	Duong (2025)
Emerging Themes and Frameworks	GAIN Framework for adoption, education, innovation, and performance; GAI&ABC Model for sustainable business model innovation through exploratory and exploitative learning.	Dwivedi (2025); Wang & Zhang (2025)
Challenges and Opportunities	Digital divide particularly affects African American entrepreneurs; need for partnerships and training. Differences across countries highlight need for tailored digital entrepreneurship strategies.	George & Mattathil (2025); Radović-Marković (2025)

The findings highlight that GenAI significantly shapes the dimensions of Entrepreneurial Orientation, particularly risk-taking, innovativeness, and proactivity. However, a critical examination suggests that much of the existing literature emphasizes technological affordances while underexploring contextual and human limitations. For instance, while GenAI reduces uncertainty and supports calculated risk-taking (López-Solís et al., 2025), this benefit often assumes access to high-quality datasets and adequate interpretive capabilities, which are not

uniformly available across entrepreneurial ecosystems. Similarly, GenAI enhances innovativeness through idea generation and organizational learning (Xu et al., 2024; Wang & Zhang, 2025), yet these outcomes depend heavily on entrepreneurs' absorptive capacity and ethical safeguards to prevent misuse (Dwivedi, 2025).

Proactivity is reinforced through predictive analytics and real-time insights, allowing entrepreneurs to anticipate shifts and act decisively (Ahmić & Šahović, 2025). Nonetheless, systemic barriers such as data biases (Wirth et al., 2025), limited contextual understanding (Wach et al., 2023), and digital illiteracy (Murungu, 2025) constrain inclusivity, creating risks of uneven benefits. This paradox indicates that GenAI may amplify advantages for digitally advanced firms while marginalizing others.

The discussion could be expanded with practical implications for entrepreneurship education and development. Curricula should integrate not only AI competencies but also training in risk evaluation, data literacy, and ethical reasoning. For policymakers, fostering equitable access to AI infrastructure, creating transparent regulatory frameworks, and supporting capacity-building programs are essential to ensure that GenAI-driven EO outcomes are sustainable, responsible, and broadly accessible.

Ethics Declaration

This research did not involve human participants, animals, or sensitive data requiring institutional ethical clearance. The study is based exclusively on a systematic review and bibliometric analysis of previously published academic sources. All materials used have been properly cited, and no ethical approval was required for this type of research.

AI Declaration

The authors acknowledge the use of artificial intelligence tools exclusively to refine and draft English phrases in this manuscript. All conceptual development, analysis, and conclusions are entirely the responsibility of the authors, and AI-generated suggestions were critically reviewed, adapted, and validated to ensure originality, accuracy, and academic rigor.

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Acceleration Programs and Entrepreneurial Competences: Case Study of the Startup Point Program

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Abstract: This paper evaluates the impact of the "Startup Point" program on the development of entrepreneurial competencies through a case study with questionnaires applied to participants from six editions. The program, focused on validating business models in innovative areas, offers mentorships, boot camps, and pitching sessions. Based on the data, 95% of participants reported significant advances in competencies, including leadership, innovation, and resilience, as well as positive experiences in collaborative and practical activities. The results indicate that the program was transformative in empowering entrepreneurs to face market challenges, create sustainable ideas, and strengthen the regional ecosystem. Mentorship was particularly highlighted as a key factor, offering personalized guidance and valuable insights. However, opportunities for improvement were identified, such as the need for post-program follow-up and expansion to other regions. The Startup Point program not only reinforced the participants' competencies but also established itself as an efficient acceleration model capable of significantly contributing to local and national economic progress.

Keywords: Entrepreneurial Competencies; Acceleration Programs; Mentorship

1. Introduction

Entrepreneurship has emerged as a crucial driving force for economic and social development, particularly in economies seeking to foster innovation and global competitiveness. The creation of new businesses and the ability to innovate are seen as central pillars for sustainable economic growth, as argued by Schumpeter with his theory of "creative destruction" (Schumpeter, 1934). In this sense, entrepreneurs are the primary agents of this transformation, introducing new products, processes, and business models that replace old ones. However, to play this role effectively, entrepreneurs need a robust set of competencies that enable them to face the challenges of increasingly dynamic and competitive markets (Dornelas, 2008). In this context, startup acceleration programs emerge as a strategic response to equip entrepreneurs with the tools needed to convert ideas into sustainable businesses. These programs offer not only access to specialized mentoring but also a collaborative learning environment that fosters experimentation and personal and professional growth (Clarysse et al., 2015).

The "Startup Point" program aims to help young entrepreneurs develop critical competencies for business success, such as resilience, innovation, decision-making, and risk management (Man & Lau, 2000). The program is structured to provide participants with a combination of practical learning through bootcamps and workshops and direct access to networks of mentors, investors, and other professionals in the entrepreneurial ecosystem. This approach aims to accelerate the startup development process, helping entrepreneurs overcome common challenges and adapt to constant market changes (Kirzner, 1973).

This study seeks to obtain empirical evidence of the dynamics of acquisition and development of entrepreneurial competencies among participants in startup acceleration programs, specifically in the case of the "Startup Point" program. The choice of a case study as a methodology is justified by the need for a detailed analysis of the concrete impact that acceleration programs can have on the entrepreneurial trajectory of participants (Yin, 2009). The adopted methodology is based on quantitative approaches through questionnaires applied to participants. The analysis of the results provided an integrated view of how the program contributed to the development of specific competencies, such as leadership, innovation, and problem-solving capacity, as well as the difficulties faced during the process.

The interest in this topic arises from the growing importance attributed to entrepreneurial education, not only as a tool for individual development but also as a means of promoting innovation and economic growth at the regional and national levels (Fayolle & Gailly, 2008). Programs like "Startup Point" play a fundamental role in bringing academia, businesses, and investor networks closer together, providing entrepreneurs with the resources and opportunities they need to transform ideas into viable businesses. With this study, the aim is to

contribute to the debate on the effectiveness of acceleration programs in developing entrepreneurial competencies and strengthening the innovation ecosystem, highlighting the main benefits and challenges associated with these initiatives.

2. Literature Review

2.1 Entrepreneurship and Start-up Companies

The Global Entrepreneurship Monitor (GEM) defines entrepreneurship as "any attempt at new business or new venture creation, such as self-employment, a new business organization, or the expansion of an existing business, by an individual, a team of individuals, or an established business (Buah, 2024; Rusu and Roman, 2017; GEM 2001).

The term "entrepreneurship" was initially associated with Richard Cantillon (1755) and Jean-Baptiste Say (1800), who defined entrepreneurs as individuals who take risks by investing their own capital in businesses. Later, in 1934, J. Schumpeter linked entrepreneurship to innovation, asserting that the essence of entrepreneurship lies in the ability to identify and exploit new business opportunities, which involves creating new ways of utilizing resources. Schumpeter also described the entrepreneur as someone who drives processes of "creative destruction," resulting in the creation of new production methods, products, and markets (Schumpeter, 1934). In 1985, Pinchot introduced the concept of intrapreneurship, referring to entrepreneurial individuals acting within their organizations (Pinchot, 1985).

Entrepreneurship is a multifaceted concept that encompasses a diverse array of ventures, including small enterprises, social initiatives, technology start-ups, and sustainability-oriented projects. Each form of enterprise presents distinct opportunities and challenges, which are shaped by market conditions, industry-specific dynamics, and the underlying motivations of the entrepreneur (Bhavsar, 2024).

Start-up companies play a crucial role in driving economic growth and fostering innovation (Argaw and Liu, 2024). According to Steve Blank, a startup is a company created to search for a replicable and scalable business model (Blank, 2013). This definition emphasizes two critical elements: reproducibility—the ability to repeatedly sell a solution, and scalability—the potential for substantial growth (Chernysh and Chelembiienko, 2019). Eric Ries further describes startups as "human institutions designed to deliver a new product or service under conditions of extreme uncertainty" (Ries, 2011, p. 7). Ries (2010) argues that innovation is pivotal to a company's success; however, he emphasizes that innovation inherently carries a degree of risk. Therefore, start-ups must assess the level of innovation they are both capable of and willing to pursue. Typically, start-ups leverage existing technologies in novel contexts, develop new business models, or introduce products or services to new markets or customer segments that have previously been underserved. An essential aspect of Ries' (2010) definition is the context in which innovation occurs, with the author noting that start-ups operate under conditions of profound uncertainty. Factors such as the founder's vision, team cohesion, and innovation management are crucial in driving success, whether in developed or emerging markets (Argaw and Liu, 2024).

2.2 Entrepreneurial Competencies

Entrepreneurial competencies are described as fundamental capacities that enable individuals to act effectively in diverse contexts, including individual, organizational, and social levels, especially in a globalized and dynamic environment (Gibb, 1998). These competencies range from intuitive decision-making to the ability to negotiate, persuade, and manage resources creatively.

Authors such as Mamede and Moreira (2005) highlight that these competencies go beyond the individual and are intrinsically linked to practical management, including opportunity identification, network creation, and organizational commitment. Boyles (2012) suggests grouping them into three main categories: cognitive, social, and action-oriented. Meanwhile, Lackéus (2015) emphasizes that they integrate knowledge, skills, and attitudes that drive value creation.

Man and Lau (2000) identified five main areas of entrepreneurial competencies: i) opportunity competencies (identification and exploration of businesses); ii) conceptual competencies (innovative perception and risk assessment); iii) administrative competencies (efficient resource management); iv) strategic competencies (planning and executing strategies); and v) commitment competencies (dedication to the business, even in adversity).

Other authors, such as Cooley (1990) and Filion (1991), highlight specific competencies, such as persistence, planning, networking, and self-confidence, while Burgoyne (1989) and Sánchez (2011) broaden the approach by relating these competencies to competitive success and adaptability in the 21st century.

Based on this, the following key entrepreneurial competencies can be identified:

- Opportunity seeking and initiative,
- Persistence,
- Commitment,
- Quality and efficiency orientation,
- Risk-taking,
- Goal setting,
- Information seeking,
- Systematic planning and monitoring,
- Persuasion and networking,
- Independence and self-confidence,
- Opportunity competencies (identifying and exploring business opportunities),
- Relationship competencies (primary, secondary, and tertiary personal contacts),
- Conceptual competencies (assessing risks and perceiving situations innovatively),
- Administrative competencies (efficient management of human, physical, financial, and technological resources),
- Strategic competencies (selection and implementation of long, medium, and short-term strategies),
- Commitment competencies (continuous dedication to the business, even in challenging times).

(Boyles, 2012; Burgoyne, 1989; Cooley, 1990; Filion, 1991; Gibb, 1998; Lackéus, 2015; Man e Lau, 2000; Mamede e Moreira, 2005; Mitchelmore e Rowley, 2010; Sánchez, 2011).

3. Methodology

The literature review demonstrated that understanding entrepreneurial competencies is essential for success in today's business world. Various scholars have addressed this topic, offering valuable perspectives on the skills and qualities required to face the challenges of a turbulent and globalized business environment (Mitchelmore & Rowley, 2010).

This research aims to obtain empirical evidence of the dynamics involved in the acquisition and development of entrepreneurial competencies and understand their impact on participants.

To comprehend these dynamics, a case study was conducted to analyze the impact of the Startup Point program on its participants through a quantitative approach using questionnaires administered to participants from various editions of the program.

To achieve the general objective of analyzing the impact of the Startup Point program on its participants and to gather their opinions and perceptions, the data collection method adopted was based on questionnaires administered to participants of the six editions of the program.

To facilitate data analysis and availability, a questionnaire was administered to all 40 participants from the six editions of the program during May to September 2024. The questionnaire was conducted online using the Google Forms platform, following a pre-formulated script. Table 1 outlines the relationship between the questionnaire's categories/questions and the specific objectives they aim to address.

Table 1: Objectives of the questionnaire

Question Topic	Specific Objective
Program	Assess the level of prior familiarity of participants with "Startup Point" and understand whether their expectations were met when participating in the project.
Monitoring and mentoring	Evaluate the quality of the support provided by mentors during the bootcamps and understand the impact of this guidance on the development of participants' business ideas.
Idea Development	Identify the influence of the areas covered in the bootcamps on the development of participants' business ideas, as well as evaluate the importance of practical feedback sessions and collaboration with other entrepreneurs.
Presentation preparation	Evaluate the role of preparing the final speech (PITCH) in the overall experience of participants at the event and identify aspects considered important in the preparation and presentation of projects at "Startup Point".
Entrepreneurial Skills	Identify the entrepreneurial skills that you consider to have developed and how participation in the program improved them.
Improvement and Suggestions	Gather feedback from attendees on improvements or suggestions for future editions of the event based on their personal experience.
Learning and Final Considerations	Assess how much participants believe that their participation in the "Startup Point" program will influence the future development of projects or business ideas. Allow participants to share any additional information or final feedback about their participation in the "Startup Point" program and summarize their experience in one sentence.

4. Case Study: Startup Point Program

Startup Braga, an innovation hub of InvestBraga, has the mission to support entrepreneurs by providing the tools and knowledge necessary to achieve their goals and develop projects with global potential in areas such as nanotechnology, health, digital economy, and sustainability. Since 2014, it has promoted pre-acceleration, acceleration, and incubation programs, along with training and networking events, leveraging local resources such as the University of Minho and INL. In 2020, despite the pandemic, it strengthened its national and international reputation, raising €13.6 million in investments and attracting startups from six countries. Currently, it has supported 156 startups, contributing to job creation and the economic growth of Braga. Recognized in the "Europe's Leading Start-Up Hubs 2024" ranking, it stands out as one of the leading entrepreneurship centers in Portugal (InvestBraga, 2021; Jornal de Negócios, 2024).

Startup Point's program, in partnership with Startup Braga and Liftoff from AAUMinho, has had six editions and aims to assist entrepreneurs in validating their business models and understanding the problems they seek to solve. It offers individual mentorships and five intensive bootcamps: Ideation, Business Model Design, Go to Market, Finance for Startups, and Pitching & Storytelling, culminating in a pitching session and feedback before the final presentation. It is targeted at entrepreneurs with early-stage ideas, especially in innovative sectors such as Digital Economy, Health, Biotechnology, Nanotechnology, and Sustainability. The program is accessible to higher education students and the general community, promoting the participation of motivated and creative teams (Startup Braga, n.d.).

Since its launch in 2019, the Startup Point program has played a crucial role in supporting entrepreneurs and developing innovative business ideas. With six editions completed by 2024, the program adapts to the dynamic needs of the entrepreneurial ecosystem. Notable ideas include solutions in areas such as sustainability, health, technology, education, and tourism. Examples include startups like Portugal Bugs (sustainable insect production), BPatch (nanotechnology materials for wound healing), Chronic Boutique (commercial art), and EARLY (early Alzheimer's diagnosis). In the 2024 edition, standout ideas included the sustainable beverage "Oh Chata!" and the book exchange platform MIMO. The program continues to impact on the entrepreneurial ecosystem by promoting innovation and business opportunities (Startup Braga, n.d.).

5. Results

The results obtained from the analysis of questionnaires administered to participants of the Startup Point program highlight the program's positive impact on several dimensions relevant to entrepreneurial development. This study received responses from 20 participants, resulting in a response rate of 50%.

This small sample size suggests that the results should be analysed carefully.

Regarding prior knowledge of the "Startup Point" program, 70% of respondents reported low or moderate familiarity (levels 2 and 3). Only 20% demonstrated high or very high familiarity (levels 4 and 5), while 10% stated they were unfamiliar with the program (level 1) (Figure 1). These data underscore the program's role in raising awareness and engaging individuals with varying levels of exposure to the entrepreneurial ecosystem.

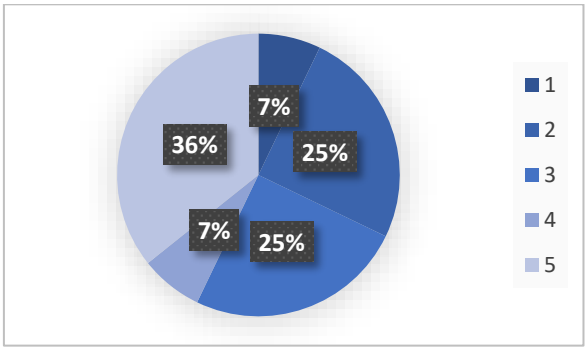


Figure 1: Degree of familiarity with Startup Point before participation

In terms of expectations for the "Startup Point" program, 95% of respondents expressed high satisfaction, with 60% considering their expectations fully met (level 4) and 35% stating they were exceeded (level 5) (Figure 2). Similarly, 95% of respondents evaluated the bootcamp experience positively, with 60% rating it as good (level 4) and 35% as excellent (level 5). Only one participant rated the experience as reasonable (level 3), reinforcing the high quality of the activities carried out (Figure 3).

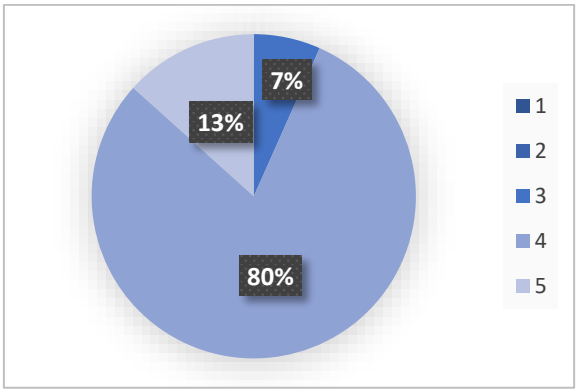


Figure 2: Expectations about the "Startup Point" program

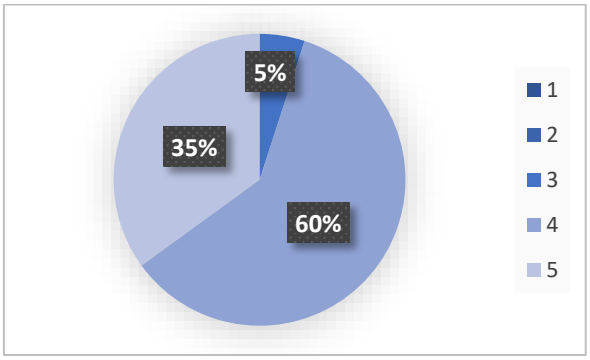


Figure 3: Evaluation of the overall experience of the bootcamps.

The quality of mentor support was widely recognized, with 65% of respondents rating it as excellent (level 5) and 35% as good (level 4). Additionally, 90% of respondents considered the guidance received to be very positive for the development of their business ideas, with 65% assigning a level 4 and 20% assigning a level 5. Only two participants rated the guidance as reasonable (level 3), and no negative feedback was received, demonstrating the significant impact of mentorships (Figure 4).

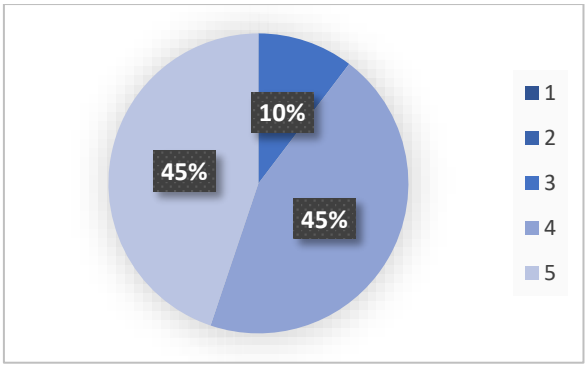


Figure 4: How did the guidance you received at the bootcamps contribute to the development of your business idea?

Regarding idea development, 95% of respondents found the exchange of ideas among entrepreneurs positive. Of these, 45% assigned level 4 (positive) and 50% level 5 (very positive). Similarly, brainstorming sessions conducted within the scope of the "Startup Point" program were positively evaluated by 95% of respondents, with 47% rating them as good (level 4) and 48% as excellent (level 5) (Figure 5). This collaborative environment proved to be a crucial element for generating new perspectives and insights.

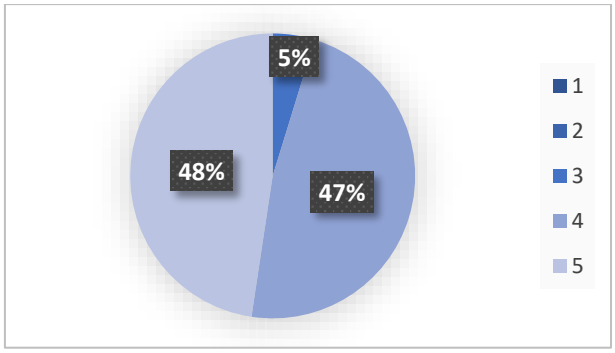


Figure 5: Effectiveness of brainstorming and group discussion to generate new perspectives and insights

Considering the pitch/presentation of projects during the job fair held as part of the "Startup Point" program, 95% of respondents evaluated the experience positively. For 50%, the presentation was considered good (level 4), while 45% deemed it excellent (level 5) (Figure 6). Additionally, the feedback received during these presentations was highlighted as one of the program's most enriching moments, helping participants identify improvement points and gain confidence in their ideas.

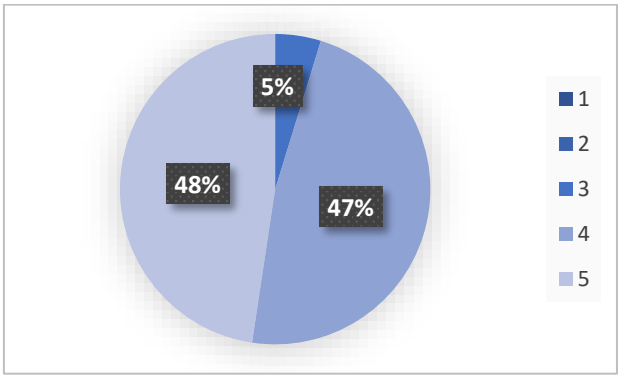


Figure 6: Experience of presenting the project at the job fair during the"Startup Point" program.

In terms of developing entrepreneurial competencies within the "Startup Point" program, 70% of respondents identified advances in opportunity-seeking and initiative, 60% identified persistence as a developed competency, and 50% indicated that persuasion and networking skills were developed. Administrative competencies were the least improved, with only 25% of participants reporting progress, while 40% highlighted improvements in strategic competencies. Overall, 90% of respondents considered the "Startup Point" program

relevant to developing their ability to identify business opportunities, and 90% also positively assessed its impact on leadership and collaboration in multidisciplinary teams.

Finally, the program's impact on the future development of projects was highlighted by 95% of respondents. Of these, 50% considered that their participation in the "Startup Point" program would have a very significant impact on the future development of their projects or business ideas, while 45% rated it at level 4, meaning they considered it significant (Figure 7). All participants described the experience as transformative, highlighting the quality of the organization, the availability of mentors, and the positive environment of the program. Despite the overwhelmingly positive feedback, some suggestions for improvement include extending the program's duration, offering more individual mentorship sessions, and involving experienced founders as mentors. These changes could make the program even more effective and enriching, solidifying its role as a reference point for the entrepreneurial ecosystem.

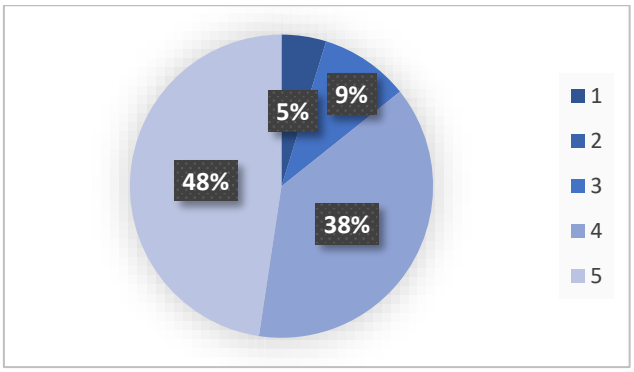


Figure 7: Impact on the future development of the project or business idea

6. Discussion of Results

The analysis of results obtained through the questionnaires demonstrates, for the sample studied, the profound and comprehensive impact of the "Startup Point" program on developing entrepreneurial competencies and building a solid foundation for creating new startups.

It's important to note that, since there was only a sample of 20 questionnaires, the results need to be discussed carefully.

The data show that many participants began the program with limited knowledge of the startup development process but reported a significant increase in practical, strategic, and interpersonal competencies throughout the journey. Additionally, there was a clear shift in how participants viewed entrepreneurship, developing a more critical and analytical perspective.

From the outset, the program was structured to offer an immersive experience, aligning theory and practice, which allowed participants to face market challenges with greater confidence and determination. This innovative approach confirms the principles of Kolb's experiential learning (1984), which states that knowledge is most effectively acquired when applied in concrete and practical situations. Participants highlighted that this methodology was essential for improving market understanding and creating innovative and sustainable solutions.

The results also pointed to significant gains in essential entrepreneurial competencies such as innovation, adaptability, and resilience. These competencies are indispensable for navigating competitive and dynamic environments characteristic of the startup ecosystem. Additionally, participants reported advances in areas such as leadership and resource management, indicating that the program provided a holistic training that prepared them to approach their projects with greater clarity and structure. Gibb's theory (1998) on the importance of entrepreneurial competencies in dynamic business environments reinforces this perception, emphasizing that adaptability and risk management are crucial for entrepreneurial success.

One of the most valued aspects of the program, according to the questionnaires, was mentorship. Participants emphasized that the support of experienced mentors was fundamental in refining business ideas, correcting early mistakes, and adjusting strategies. Each mentor brought a unique and specialized approach, creating an environment of knowledge exchange and inspiration. These results align with the studies of Clarysse et al.

(2015), which highlight the importance of mentorship in acceleration programs, both for developing technical competencies and strengthening entrepreneurs' interpersonal skills.

Beyond technical competencies, participants reported notable advances in soft skills such as effective communication, empathy, negotiation, and teamwork. Interaction with mentors and other participants was crucial for developing these often-underrated skills, which play a central role in a venture's success. According to Plaza et al. (2016), interpersonal competencies are as important as technical ones, as they strengthen relationships and the ability to lead and inspire teams. Participants recognized that these skills helped them communicate their value propositions and establish more effective strategic partnerships.

Another highlighted point was the program's impact on maturing business ideas. Participants were encouraged to explore their proposals practically and collaboratively, receiving constant feedback from mentors and peers. This collective approach was considered essential for broadening perspectives, identifying opportunities, and improving initial proposals. In Vygotsky's theory of collaborative learning (1978), knowledge is most effectively constructed in environments of social interaction and mutual support, where idea exchange drives innovation and growth.

Despite positive results, participants suggested some important improvements for the program. One of the main recommendations was implementing extended follow-up after the program's conclusion to help startups overcome initial challenges and establish themselves in the market. This continuous support is highlighted by Lackéus (2015) as a crucial factor for the long-term success of startups, offering strategic support during the most critical stages of development. Additionally, expanding the program to other regions and educational institutions was suggested, which could broaden the initiative's reach and benefit a larger number of young entrepreneurs, strengthening the entrepreneurial ecosystem at regional and national levels.

In conclusion, the results demonstrate that the "Startup Point" program provided a transformative and comprehensive learning experience for participants. By combining theory and practice, the program equipped entrepreneurs with essential tools and knowledge to face the complex challenges of the startup ecosystem. The positive impact was not limited to developing technical competencies but also extended to interpersonal competencies and maturing business ideas. This acceleration model stands out as an effective approach to promoting the development of entrepreneurs prepared to innovate and lead in dynamic markets.

Additionally, the program has established itself as a strategic tool for strengthening the regional entrepreneurial ecosystem, promoting the creation of new startups and generating economic and social impact. Thus, initiatives like "Startup Point" have the potential to transform not only the individual trajectories of entrepreneurs but also significantly contribute to sustainable economic development and the creation of a resilient and collaborative innovation environment.

7. Conclusion

Entrepreneurship plays a central role in economic growth, serving as a driver for innovation, job creation, and market transformation. Entrepreneurs are agents of change who, by introducing new products, services, or business models, foster economic and social progress, generating value not only for themselves but for society (Schumpeter, 1934). In this context, entrepreneurial skills emerge as key elements for the sustainable success of business ventures, enabling individuals not only to identify and seize opportunities but also to navigate uncertainties and lead projects effectively. Such skills include creativity, resilience, leadership, and problem-solving abilities, which are crucial for survival and growth in dynamic business environments (Gibb, 1998).

This study aimed to analyze the impact of the "Startup Point" program, promoted by Startup Braga, on the development of entrepreneurial competencies among its participants. The research sought to understand how the program contributed to empowering young entrepreneurs, explore the role of the skills developed in strengthening the regional entrepreneurial ecosystem, and identify possible improvements for future editions. The focus was mainly on the development of critical entrepreneurial skills, such as the ability to identify opportunities, innovate, lead, and demonstrate resilience, which are essential for the sustainability and competitiveness of new businesses.

The methodology adopted, based on questionnaires, provided a detailed understanding of the program's effects on its participants. The data collected highlight that, for many, the program was a turning point in their perception of entrepreneurship, awakening their "entrepreneurial spirit" and boosting their confidence in overcoming market challenges.

The analysis of the results revealed that the "Startup Point" program played a transformative role in empowering young entrepreneurs and strengthening the regional entrepreneurial ecosystem. The program was structured to support the development of essential skills, including the ability to identify and seize opportunities, innovation, leadership, and resilience, all critical factors for the sustainability of new ventures (Gibb, 1998).

The Startup Point program has thus established itself as an essential platform for regional innovation and development. As Schumpeter argues, entrepreneurship is a driver of "creative destruction," where the introduction of new ideas and technologies reshapes the economic landscape, creating opportunities and fostering economic and social progress (Schumpeter, 1934).

However, the study identified areas for improvement, including the need for more extensive post-program support to ensure that projects consolidate and overcome initial market challenges, a suggestion aligned with Lackéus' studies on continuous support as essential for the long-term success of startups (Lackéus, 2015). Additionally, participants proposed expanding the program to other regions and educational institutions to broaden its reach and foster a solid entrepreneurial culture at the national level.

For future editions, it is recommended to deepen market analysis and strategic planning methodologies, as observed by Man and Lau (2000), who identify these skills as central to startup success. Moreover, incorporating sessions focused on emerging topics such as sustainability and social responsibility could not only expand participants' business vision but also align their practices with contemporary market demands.

Despite the promising results, the study presented some limitations that should be considered. Not all participants responded to the questionnaires—this study had a response rate of only 50%, limiting the scope of the quantitative data. Additionally, extending the response period for the questionnaires in the hope of more responses left little time for their analysis, preventing a more advanced statistical analysis of the data, which could be pursued in future research. These limitations highlight the need to reinforce communication and commitment with participants in future investigations to ensure a complete and more representative dataset.

For future projects, it is suggested i) complement this analysis with a qualitative study based on questionnaires; ii) implement a post-program follow-up system, allowing for a longitudinal study that investigates the evolution of startups over time. This follow-up would provide deeper insights into the challenges and achievements of entrepreneurs in a more mature phase of their businesses, contributing valuable data on the long-term impact of acceleration programs. Additionally, expanding the Startup Point program to other regions and incorporating partnerships with educational institutions could make the program more inclusive, promoting entrepreneurship in diverse contexts and enabling regional comparisons that would enrich the literature on entrepreneurial education and innovation.

In summary, the Startup Point program not only strengthened participants' competencies but also established itself as an efficient acceleration program model capable of significantly contributing to local and national economic progress.

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Ethics Declaration

This study did not require ethical clearance for the research referred to in this paper.

AI Declaration

No AI tools were used in the development of this paper.

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